MINISTRY OF SOCIAL WELFARE
JERUSALEM ISRAEL

RESEARCH ON REHABILITATION OF BLIND AND VISUALLY HANDICAPPED IN OPERATING IBM PUNCH-CARD MACHINES

REPORT NO. 3

By

EZRA SHAPIR

Prepared under a grant from the Vocational Rehabilitation Administration, Department of Health, Education and Welfare, Washington D.C., U.S.A.

Jerusalem, September 1966

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The Office Mechanisation Centre

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JERUSALEM, ISRAEL

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Principal Investigator: Dov Chevion
Programme Director: Yehuda Schiff

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FOREWORD

By Dov Chevion, Principal Investigator,
Director of the Govt. Office Mechanisation Centre.

1. Report No. 3 closes a definite phase in the research on rehabilitation of the blind and visually handicapped in ADP equipment, and provides an appropriate opportunity to sum up the results of the research. It can now be said with confidence,

a) that blind and visually handicapped persons - after suitable selection (as also in the case of sighted persons) - can be trained successfully in the preparation of control panels and the operation of punch card machines. Report No. 2 has shown this in respect to the Sorter, while the present report, No. 3, proves the same for all other machines, such as Interpreter, Collator, Reproducer and Tabulator;

b) that a blind or visually handicapped person can successfully do the work of an operator within a punch card installation. Moreover - from the professional as well as the social point of view - the handicapped operator bears wholly satisfactory comparison with a sighted operator.

These results have in fact emerged from the first phase of the research, and we are glad to be able to give firm confirmation of them in this report.

2. The results recorded in Reports 1-3 are based on three regular courses held at the Research and Demonstration Center. Our research is based on a population of 22 pupils. Taking into consideration the high degree of heterogeneity amongst the pupils themselves, as regards intelligence and educational background, it is clear that innumerable difficulties had to be overcome in the course of the research. Our relatively small population also compelled us whilst implementing the results of this research in practice to be ready to introduce improvements and changes as and when required.

3. The degree of the success of this research is basically due to the successful solution of a number of problems, the most important of which were:

a) In all cases where vision formed an essential part in the teaching of the theory or practice of punch card machines, a tactual or audible aid had to be constructed. After many trials, a whole series of general and special aids, described in detail in the report, were finally deemed capable of compensating effectively for lack of vision. It might be said, in a way, that the story of this research is actually the story of the many tactual and audible aids and their various stages of development. The development of Card-Reading or Card-Checking instruments, as given in the

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report, is an excellent example of the problems met and their gradual solution. There is no "last word" to development and improvement. The effectiveness of the teaching, combined with careful consideration of expenditure, served as the guiding policy during our research. It now appears that a balance has been achieved between effectiveness and investment. Only use of the various tactual and audible aids and teaching methods will show whether further investment in development of the instruments is required.

Parallel with the use of tactual and audible aids, very wide use has been made of the manuals, transcribed into braille, and also tape recordings of the lessons. The lessons have been didactically adapted to the principle of teaching the whole through the tactual and audible teaching of fragments. This is quite the reverse of the method generally used with sighted pupils.

The proposed tactual and audible aids and the particular didactic approach to theory and practice form a satisfactory way to effective and economic results in teaching blind and partially blind persons to program and operate punch card machines correctly.

b) The successful acclimitization of the blind pupil as an operator in a punch card installation is governed by three considerations:

i) a tutor who knows the pupil well, and is professionally qualified, takes a personal interest in the work of the pupil in the first stage;

ii) each of the pupils performs productive work during his studies in the Research Center. This gives him self-confidence and also the opportunity of improving his working methods. However, the possibility of engaging in productive work can only be organized if the Research Center possesses its own machine installation.

iii) Before being placed in definite employment, each pupil works experimentally for a time in a real punch card installation.

Future courses will no doubt benefit by way of new ideas from a close follow-up of the pupils during work. This will also lead to a more efficient selection of candidates for future courses, which is a problem faced by ADP experts not only as regards blind, but also sighted pupils.

4. A comparison of the productivity of the sighted and blind operator is still needed and it is hoped to be able to submit data on this aspect in future reports. We are well aware of the difficulties involved in making this investigation because, as mentioned before, the population sample is not large and

individual deviations will be quite considerable. As present we may only state that blind operators placed in employment after completing our courses, do their work in a sufficiently satisfactory manner.

5. This report is devoted to the teaching methods and practice applicable to all punch card machines, with the exception of the Sorter. We hope to supplement this report in a future edition by giving a detailed breakdown of the lessons for the various machines. This has already been done in the case of the Sorter as it was found that an appropriate manual for sighted pupils did not exist. As far as other machines are concerned, the manuals which exist for sighted pupils provide a sound basis for blind students as well.

The duration of the whole punch-card machines course, both theoretical and practical, is approximately six months. It is very difficult to lay down a fixed time-schedule as the achievement of proficiency depends to a large extent on the intelligence and educational background of the pupils, especially blind pupils. However, we feel that a ratio of 2:1 applies to the length of study by a blind pupil in comparison with a sighted one. This has not yet been prov~~i~~ed, although the three courses held so far were based, more or less, on this assumption. For the time being, future courses will also be based on this ratio.

6. The close of the first phase of the research opens a new one. It is intended, in the next phase, to extend the scope of the courses by adding courses on programming and operating a computer, beginning with the 1401 or 360 punch card input and output computer and proceeding gradually, if the extended course proves successful, to a computer equipped with tape input and output. We have had quite successful experience during the last year - a number of blind pupils learned programming of Computer 1401 with encouraging results. It is clear that not all the pupils will pass the whole course, including the programming and operation of computers. However, even for pupils who are already working in punch card installations, retraining will become more and more important. Installations in Israel, as well as in other countries, are developing and converting from conventional equipment to computers, and even computer models themselves are changing very quickly. The blind pupil will be faced with the same problems as the sighted one and will have to undergo several retraining periods during his working lifetime. As we progress from the first phase of this research to the second, we hope to find an efficient way to meet this very difficult problem for the blind ADP worker in this fast-changing technological age of ADP equipment.

7. I would like to express the highest appreciation to a number of professional workers in the Research Center and in the various installations who have helped so considerably to complete the first phase of our research successfully. Special mention must be made of Mr Benny Cohen, the Chief Instructor, and Mr Joseph Tabor, Instructor and a blind ex-pupil of the course. Both of them contributed much to the crystallization and implementation of many ideas embodied in this report, which was prepared by Mr Ezra Shapir, Research Consultant at our Center. I wish also to express our thanks to Messrs Zechariah Barak, Moshe Palmai and George Grunwald, who helped Mr Shapir in the development and construction of the instruments which serve as multi-sensory aids to the blind during both the teaching and working periods.

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INTRODUCTION

This report is the third and last on the research on rehabilitation of blind and visually handicapped in operating IBM punch-card machines (conventional system).

Report No. 1 dealt in great detail with, and described very specifically the technical aspects of the standard IBM punch-card and the demonstration and operation of IBM Sorter 083.

Report No. 2, which was an evaluation of the contents of Report No. 1, contains inter alia material suitable for the initial period of study in this field. As apparently no vocational handbook exists on the Sorter, the material is of particular importance for the teaching of the blind. Knowledge of it enables the instructor - who may be an expert on the subject but not experienced in the training of the blind - to make proper contact with the blind trainees he is meeting for the first time. This personal contact between the instructor and the blind trainees is important for the following reasons:

1) It is of great value for the creation of means of communication leading to mutual understanding.
2) It enables the proper attitude to be established towards the subject during the training period.

The present report (No. 3) deals with the following machines: Alphabetic Interpreter 557, Reproducing Punch 519, Collators 077 and 088, Calculating Punch 602 and Accounting Machine 407. These machines perform data processing functions only through their control panels, which are the "brains" of the machines.

The study of these machines is divided into two categories:-

1) Theoretical, in which panel-wiring is included.
2) Practical, which covers the operation of the machines.

All the instruments and multi-sensory devices for these two categories are described in the report. These general and special aids were designed and constructed with the cooperation of the instructors and trainees during the three courses carried out at the Center. They are the core of the research.

In this report is also to be found a comparison of the methods of instruction in Israel with that of the Center. It shows the advantages of using a complete installation of machines without any time limit for the training. It is advisable that any country intending to train the blind in operating IBM machines should conduct a survey of the market and acquire the models that are used in its territory, i.e. those to which, potentially, the graduates will be attached in their work, in

order to build a typical system.

Also dealt with is the progress of the trainees while studying and working in the Center. Constant checking up and testing of their work enables a good foundation to be laid for when they are placed. The intermediate period between study and placement is used for practical experience under regular working conditions: the students are employed in installations in which they execute jobs without pay for approximately one month. Thus they learn how to work in a commercial installation, and it occasionally happens that an employer engages a trainee permanently.

METHOD OF INSTRUCTION

A training program for the blind and otherwise handicapped cannot be planned within a set time limit. The length required for training will depend on the following factors:-

1) Instructor's ability to explain.
2) Trainee's capacity for comprehension.
3) Measure of depth planned for the study of the subject.

In Israel a fourth factor is to be considered, namely, language difficulties, as most textbooks in the IBM field are in English or French, neither of which is the mother tongue of either student or instructor. In order to overcome this problem English lessons were included in the syllabus, fitted into the general program in such a way that a lesson would cover the material which had just been taught in a theory lesson on a particular machine. Thus the Originating Reference Manuals serve as textbooks for English as well. Accordingly this method has a twofold purpose: a) study of the professional language and terminology, and b) revision of material studied. Hence it is important that the English teacher should have a good knowledge of IBM work as well.

I. IBM TRAINING FACILITIES IN ISRAEL

An investigation of the training facilities in the IBM field in Israel provided the following information:

A) The IBM Education Department receives requests from clients to train workers on a particular machine or on several machines. Accordingly they organize courses to fulfil these requirements. Thus it can happen that training is provided with respect to one machine only, or on a group of machines, or even on all the machines. The length of the training period varies with the type of equipment on which training is provided.

The following are the courses provided:

1. Functional panel wiring principles - 2 weeks.
   This course is designed for beginners who wish to advance and learn planning and panel wiring. It is compulsory to pass this course before the following courses can be taken.
2. Reproducing Punch 519 - 4 days.
   This course covers all the operations of the machine including control panel wiring.
3. Alphabetic Interpreter 557 - 3 days.
   Participants have to know Alphabetic Interpreter 552 from Course No. 1 above.
4. Accounting Machine 407 - 2 weeks
   This course covers all the operations of the Accounting Machine including i.a. Summary Punch and Automatic Carriage.

5. Collator 077 or 088 - 1 week

   This course covers all the operations of the machine including control panel wiring.

6. Calculating Punch 602 - 2 weeks

   This course includes in addition to theory the actual planning of jobs. Therefore it is important for participants to have a very good knowledge of the other conventional machines as well as experience in planning and wiring.

N.B. The above courses are only theoretical and do not encompass any practical instruction on the machines.

The courses are usually held during the day, from 8.00 a.m. to 2.00 p.m., five days a week.

B) Alternative - Study-at-Work - method: Should there exist a demand for a small number of workers in a particular system and there are no candidates for courses in other systems, the situation is created where it is not possible for the IBM Education Department to open a course of studies. In such instances (which, by the way, occur often) the people are employed on the basis of an accepted psycho-technical examination. The new worker is introduced into the machine room,

one of the experienced workers in the system is attached to him and he learns while executing actual jobs. The new worker studies the literature on the subject (generally the Originating Reference Manuals) and progresses simultaneously in the actual work and in getting to know the machines.

Such a situation can be maintained for a long period or can be changed when a sufficient number of candidates is available for the IBM Education Department to open a new course.

II. TRAINING PROGRAM OF THE IBM RESEARCH & DEMONSTRATION CENTER FOR THE BLIND

Since the above described study program is unsuitable for blind trainees, a way was sought to utilize the potential of the Center to its maximum extent.

The experience gained during the first two courses at the Center, which did not have a restricted program, provided the basis for a study program for the third course. This was planned to cover about six months, at the end of which the students should know the principles of operation of the conventional IBM equipment, how to operate the machines and how to wire control panels of all the standard machines in a normal system of automatic data processing.

The general study program for the third course was planned as follows:

Hours	Group I (4 students)	Group II (4 students)
7.30-9.00	Theory of machines (and basic panel wiring)	
9.00-9.15	Break	Break
9.15-12.15	Practical work on the machines.	Lesson in control panel wiring with complicated combinations.
12.15-1.00	Break	Break
1.00-4.00	Lesson in control panel wiring with complicated combinations.	Practical work on the machines.
4.00-4.30	Break	Break
4.30-6.00	English or Braille	English or Braille

Contrary to the IBM study program, the Center's program provides practical as well as theoretical instruction.

The study of the machines in accordance with the daily programme outlined above requires a period of over six months, covering about five study days a week. The period allotted for the study of the different equipment is as follows:

PART 1

1) General data processing and Sorter 083	1 week
2) Interpreter 557	3 weeks
3) Collator 077	4 weeks
4) Reproducing Punch 519	3 weeks

PART 2

5)	Collator 088	4-5 weeks
6)	Calculating Punch 602	4-5 weeks
7)	Accounting Machine 407	4-5 weeks
	Total	23-26 weeks

The study of the machines is divided into two parts for the following reasons:

1) Such a program enables the trainees to execute in the first stage of their studies a series of operations which are relatively complete, such as: sorting (on the Sorter), interpreting the sorted material (on the Alphabetic Interpreter), checking order of sorted material (on the Collator) and reproducing the material in different ways (on the Reproducing Punch).

2) The study of the machines in Part 1 is sometimes important in a system where other conventional machines are found in addition to the Computer. It is possible for an operator who knows only these machines to be employed in the system and in time to become a programmer of the computer (this depends on his capabilities alone).

3) Such a program makes it possible to keep a check on the progress of the trainees. After completing Part 1 the students are given a vacation. A detailed discussion on each student

is then held in order to determine the extent of his grasp of the subject, his adjustment to the work and his ability to progress to the second stage of the studies which cover the remaining machines in the system. In this way it is endeavored to ensure maximum success in work for those who complete the course, while those not suited do not continue their studies in this field.

INVESTIGATION OF IBM MACHINES

A research was made on the series of machines at the disposal of the Center with the following in view:-

1) Theoretical aspect
2) Panel-wiring
3) Operation

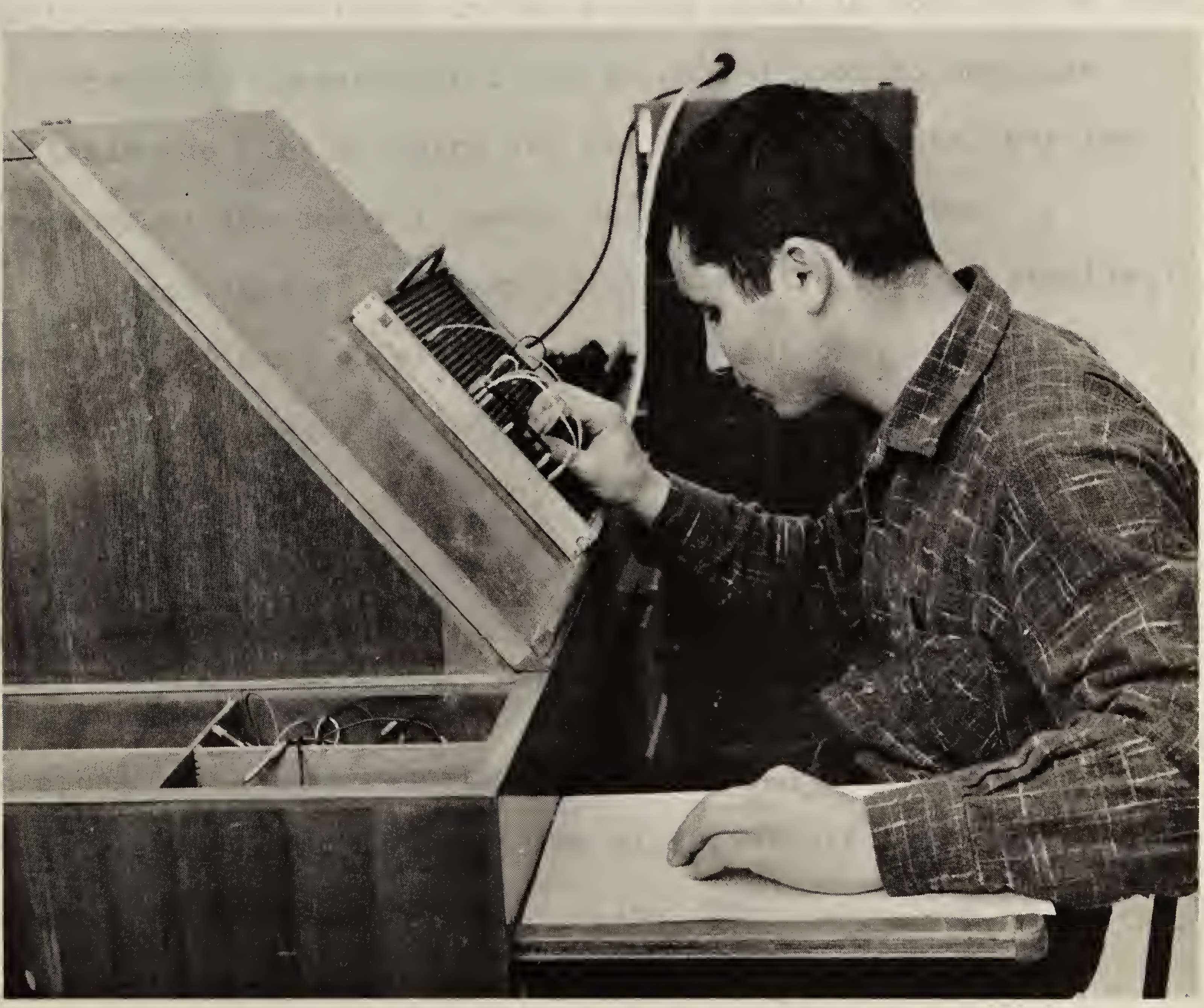
The knowledge and experience gained at the Center shows that the explanation of the theoretical aspect can be understood with the aid of the set of multi-sensory aids that are defined in Report No. 2 and in this report. Regarding the other two aspects, it should be borne in mind that panel-wiring is the basis of the studies, and this applies particularly to the teaching of the blind.

The frame for the theoretical study of these machines was built on the basis of the following IBM publications, issued by Education Planning Endicott:-

1) Education Guides
2) Operators Guides
3) Originating Reference Manuals
4) Functional Wiring Principles.

The first days of the training period should create the foundation for the building of general programs of training, a foundation which will facilitate the study of all the machines in the installation. At this time the teachers acquire a knowledge of how to evaluate the student's ability to grasp the subject, and on this basis they can plan the following series of lessons for all other machines.

The method chosen to teach panel wiring (second aspect) is to explain each unit (each function) on the panel according to the coordinates with the help of the holes in the panels. The blind operator has to count the holes vertically and horizontally and insert the appropriate wire in the correct hole. For this he needs to know the panel by heart. A mistake in the placing of the plug will give a different result from the original program.



The blind person counts the holes with his fingers or with the help of a plug that permits diagnosing the holes while penetrating them.

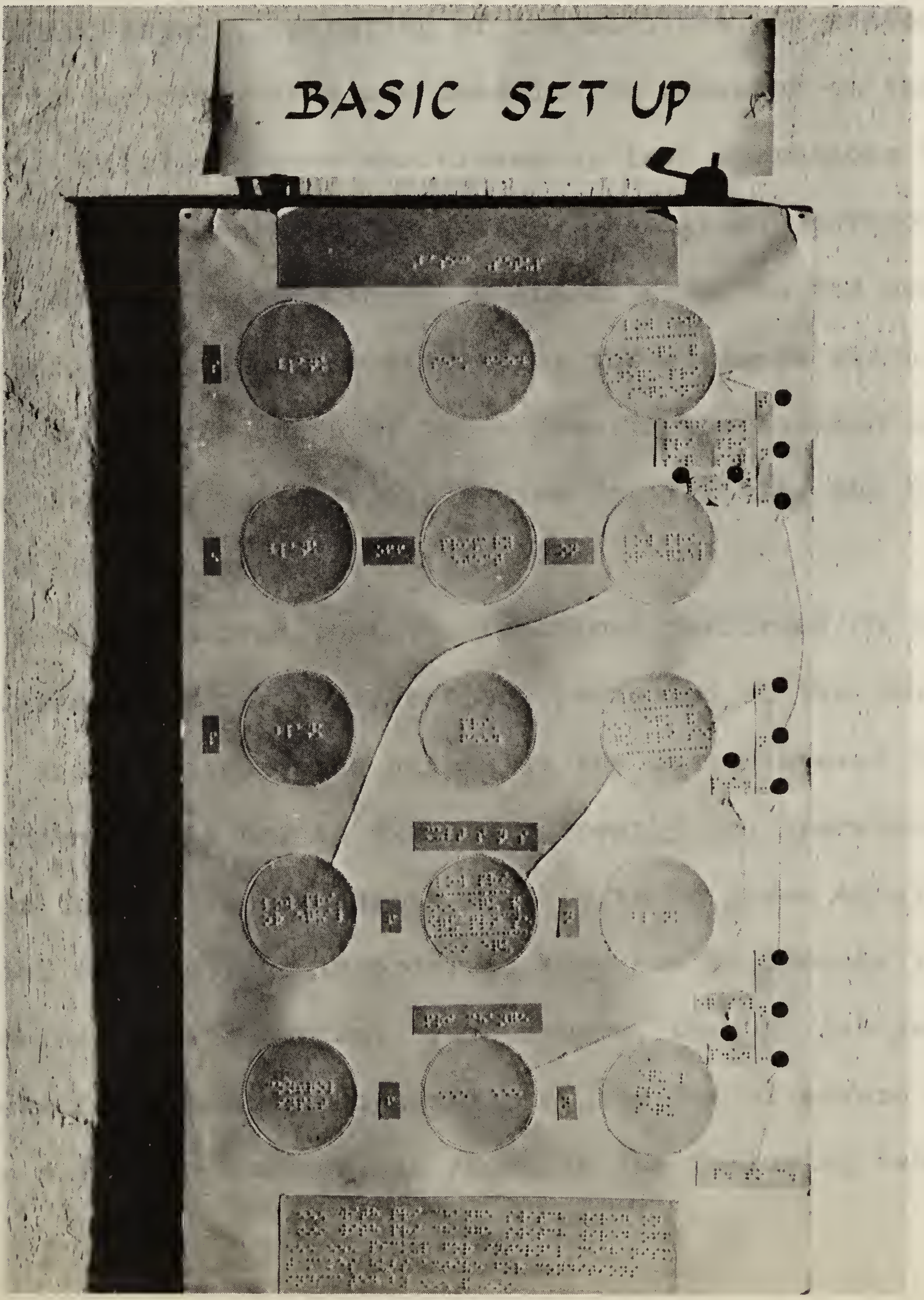
In order to lighten the burden on the already overworked memory of the blind, all the Timing Charts were copied into braille with the correct place in the wiring panel (the coordinates) for each machine indicated. This gives the blind also the time of entry and exit of the currents as well as all the functions that are found in the wiring panel in combination form.

The blind operator will not be called upon to memorize precisely the time of entry and exit of the currents, nor the structure of the control panels and their connections.

As each line of ordinary print takes two rows of braille, the braille timing chart will appear as follows: 1st row - control panel, hubs, exit-entry, cycle code, notes; 2nd row - (two letter spaces), location, timing. If there is Possible Time it is written as a third row (or indicated in another manner so as to be distinguished from Normal Time).

An example of a Timing Chart of a machine is given as an appendix to this report. It is of great assistance to every system which instructs the blind in this field to have the material copied in braille. The Timing Charts of all the machines will appear in the instruction manual.

The basic set-up of Collator 077 has been dealt with specially as it is considered to be of great importance. The blind trainee must know how it is organized for maximum ease in panel wiring. The basic set-up in braille is according to that which appears in the Originating Reference Manual of IBM Collator 077 (No. 224-3185-4, page 35).



Also of great importance is the arrangement of the Working Posts of the machines. Illustrations of these for all the machines in the installations are included herein to assist the instructor in placing the student with his carriage/s to the best advantage for himself as well as for other workers.

The third aspect, operating of the machines, is tested according to the order that was used in the research on the Sorter 083. First the work was broken up into operations that are executed on the machines by an average, sighted operator, then these operations were improved and adjusted to the needs of the blind. This included dissecting the elements which need sight and on the basis of these results the lessons and exercises that make up the whole system for teaching the blind to operate IBM machines were built.

The research proved that the functions performed on the Sorter overlap most of the operations performed on the other machines, and the experience gained at the Center showed that if the student knows how to execute correctly the operations on the Sorter there is no necessity for him to be given detailed and special explanations in order to know how to operate the other machines in the system. Furthermore, through job analysis it has been found that the operation of the Sorter covers more jobs than any other machine, as shown in the following table-

JOB ANALYSIS	MACHINES 083	557	519	077	088	602	407
Brush Adjustment	x*		x*				
Counter Resetting	x	x	x	x	x	x	x
Machine Resetting	x	x	x	x	x	x	x
Box Signing	x	x	x	x	x	x	x
Card Feeding	x	x	x	x	x	x	x
Card Inserting	x	x	x	x	x	x	x
Jam Removing	x*	x*	x*	x*	x*	x*	x*

*These jobs have the same title, but their performances vary from one machine to another, thus a special description will be given for each machine at the end of this chapter.

N.B.: Brush Adjusting, Brush Repair and Card Removing simultaneously from two stackers, occurs only in the Sorter.

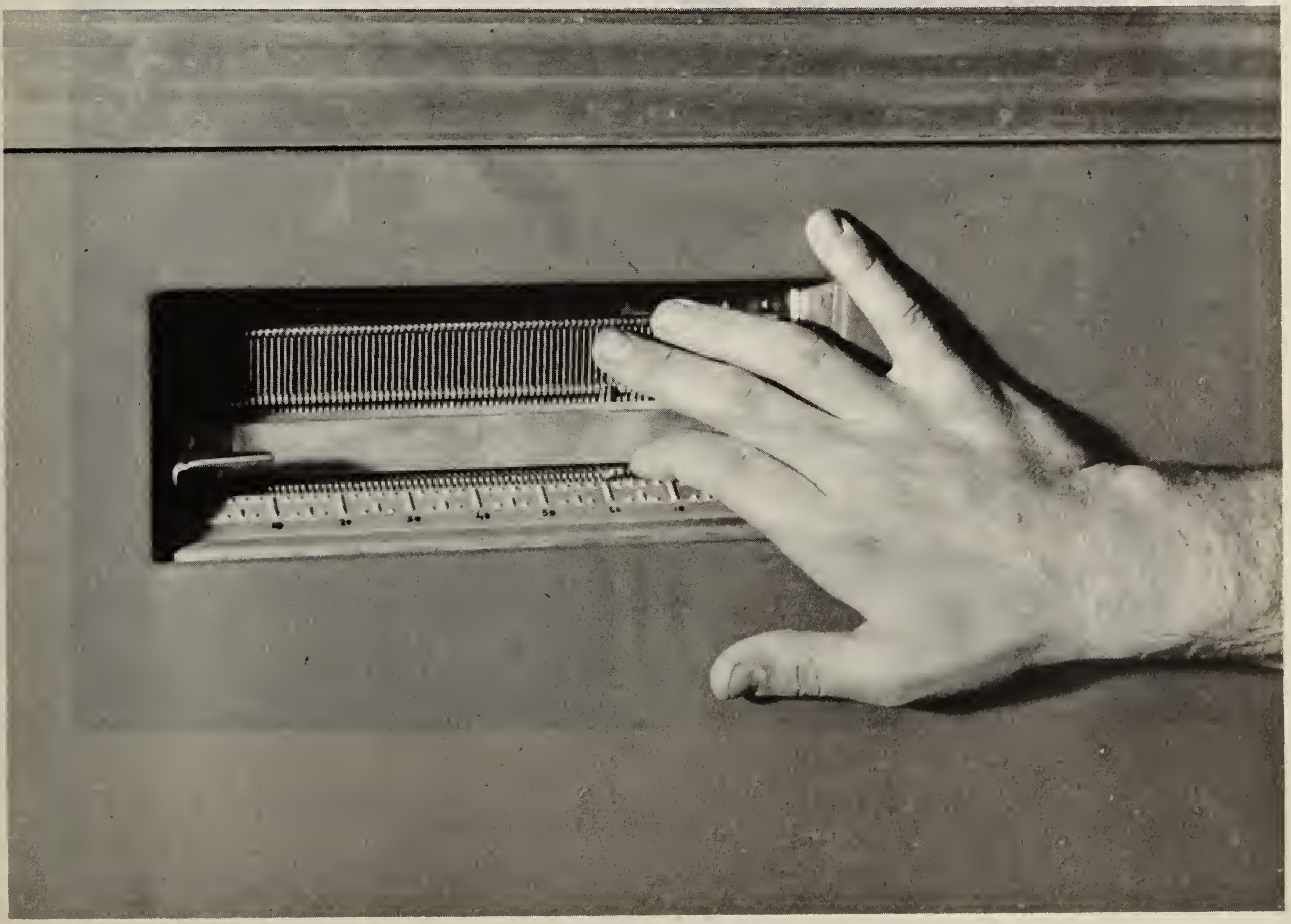
One of the problems investigated concerning the operation of the machines is the stopping of the machines while in operation and the manner of dealing with each instance. As shown in table on p.45, which deals with Special Aids, the machines generally contain a group of components for executing certain functions.

It follows that there is a strong possibility that the same failures will occur with similar basic parts in other machines. The trainee is advised to check the possible reasons according to the following table when the machine stops by itself.

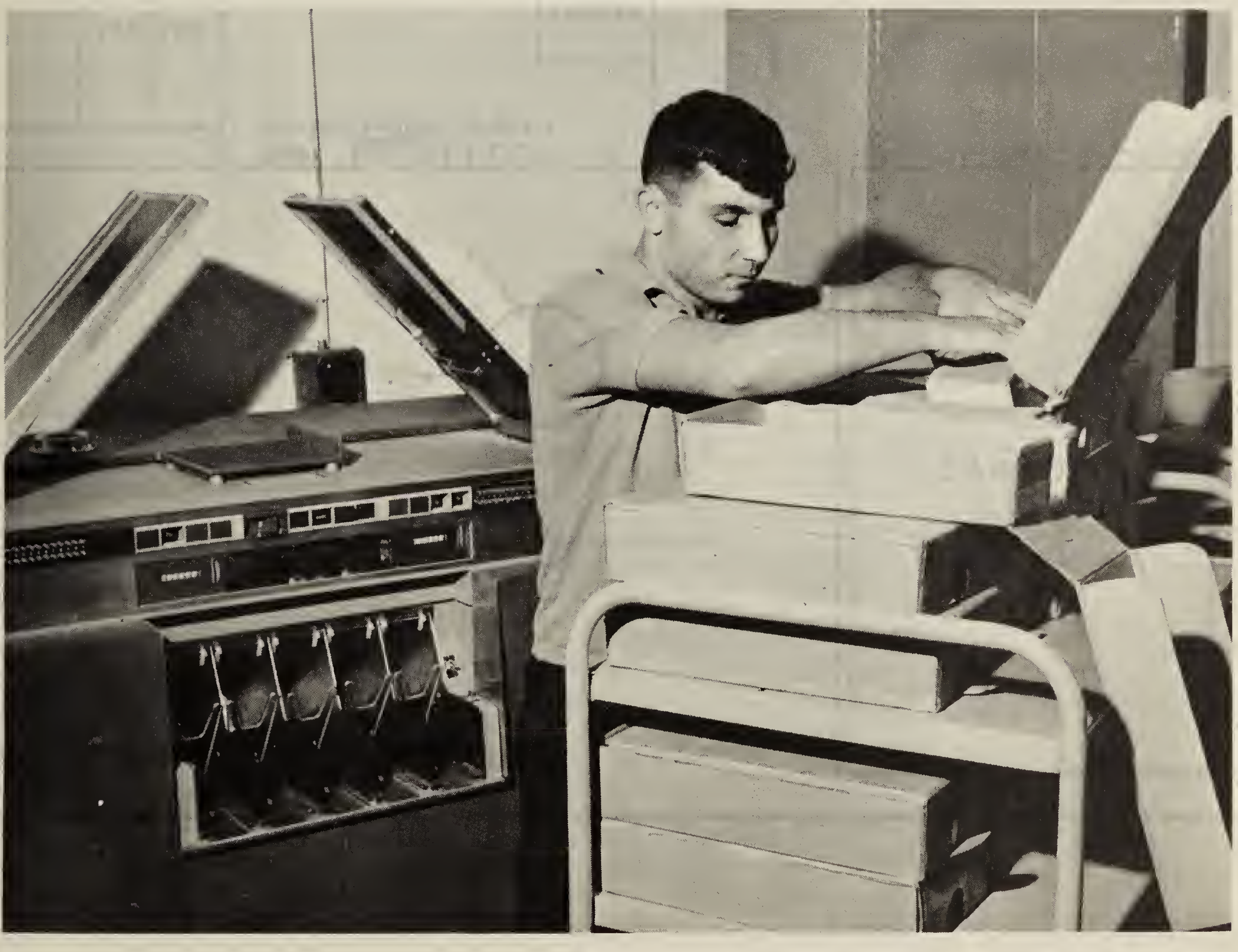
REASONS FOR MACHINES' STOPPING

Reasons for Stopping	Sorters		Alphab. Interp.	Collators		Repr. Punch	Calc. Punch	Acc. Machine
	082	083	557	077	088	519	602	407
No current	x	x	x	x	x	x	x	x
Stop knob pressed	x	x	x	x	x	x	x	x
Feed empty	x	x	x	x	x	x	x	x
Stacker full	x	x	x	x	x	x	x	x
Cards Jammed	x	x	x	x	x	x	x	x
Cover open	x	x	x	x	x	x	x	x
No weight plate in Hopper	x	x	x	x	x	x	x	x
Operation Automatic Stop		Edit Stop	Compare	Error Stop	Check Control DP or Fuse	Compare & DPBC	Reset check and insert	Echo impulse & interior counters

With reference to the above table it was found of great importance to allow the blind operator himself to read the reason for the stopping of Reproducing Punch 519 while comparing. For this reason the glass cover of the comparing unit was removed so that he could feel the hammers, and a braille scale attached in place of the ordinary scale. In this way the blind operator can find out in which columns the comparing was done. (The regular scale numbers were printed at the bottom of the braille scale).

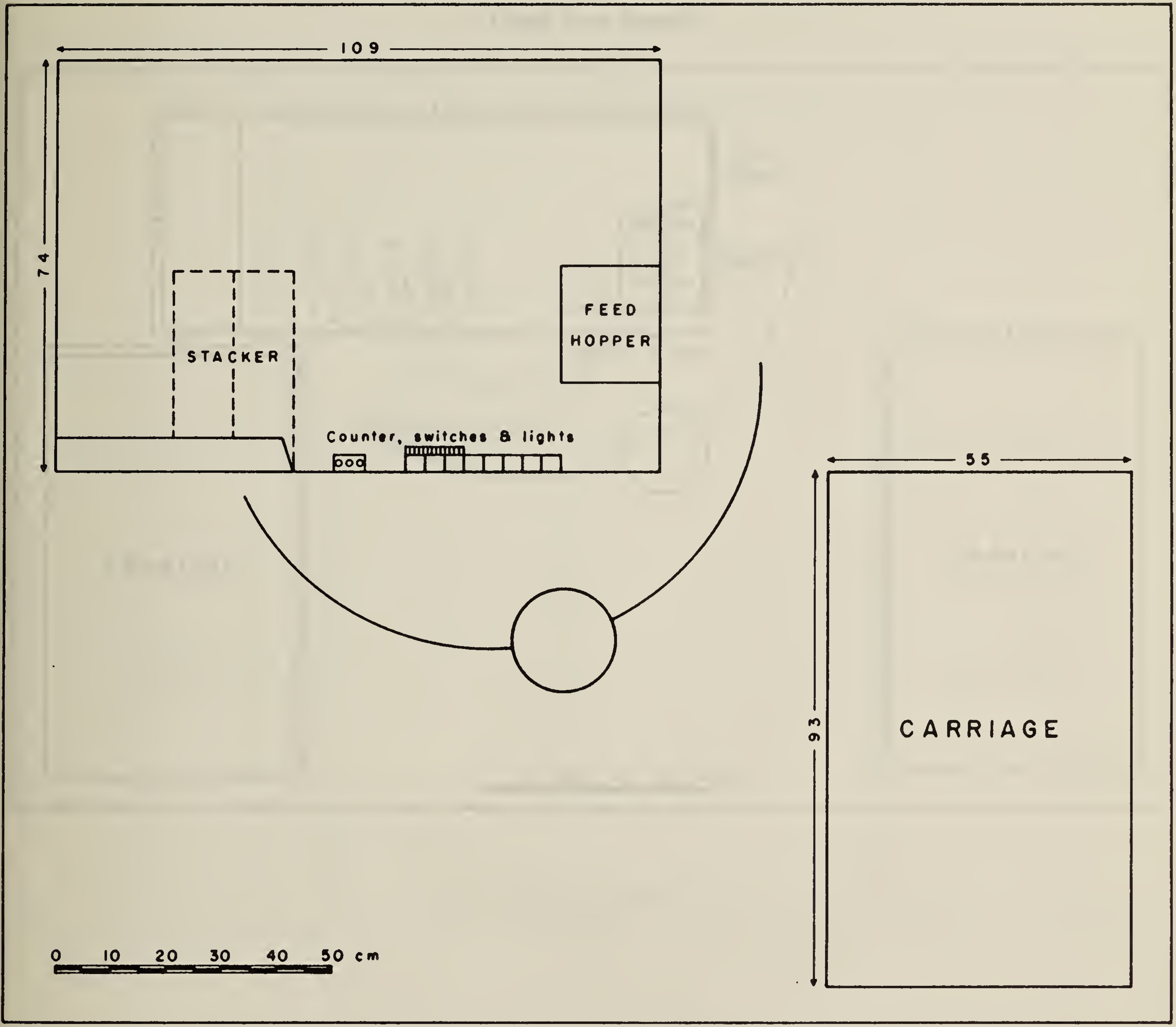


ARRANGEMENT OF MACHINES' WORKING POST



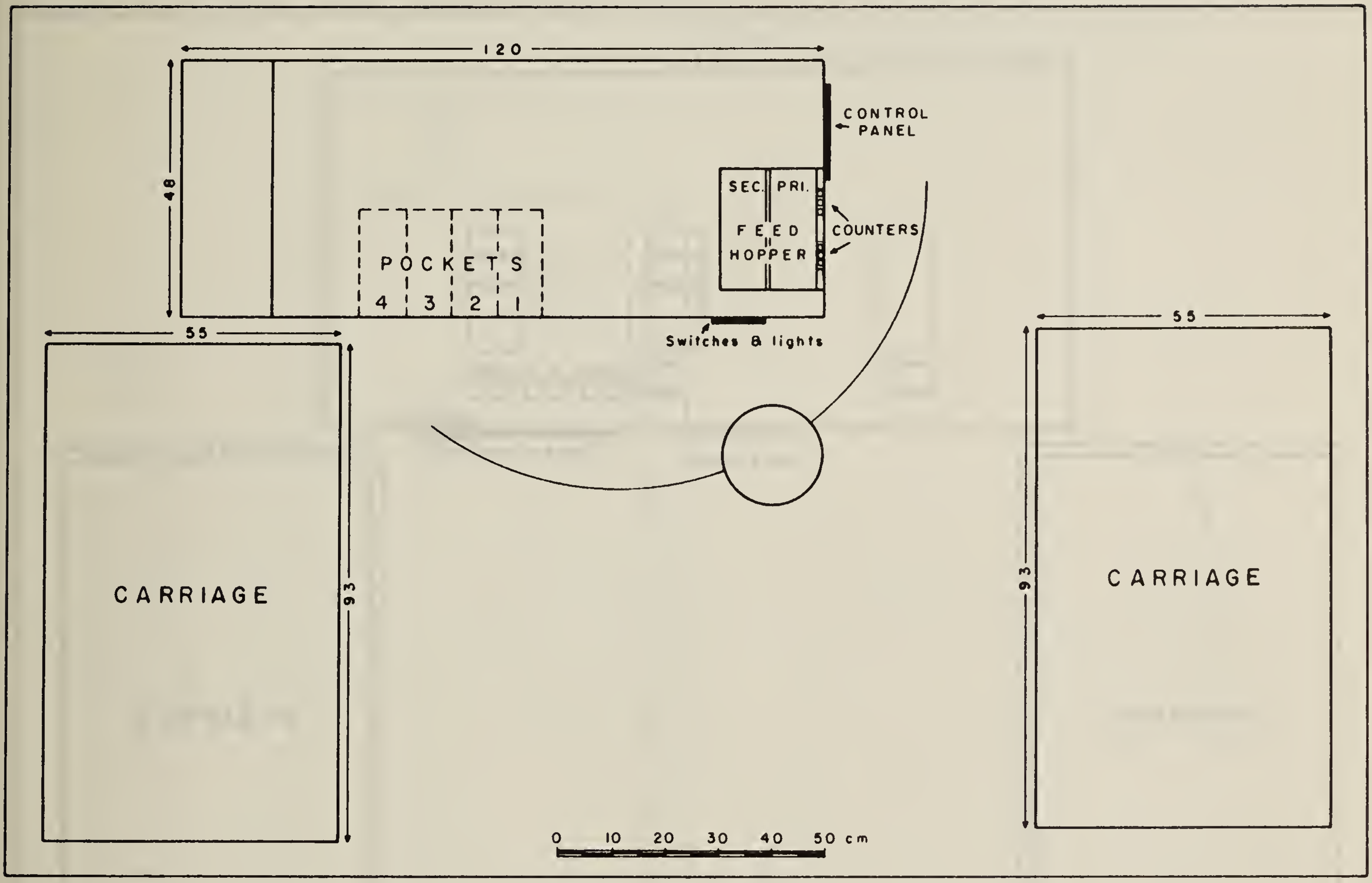
WORKING POST
OF AN IBM 557 ALPHABETIC INTERPRETER

(View from above)

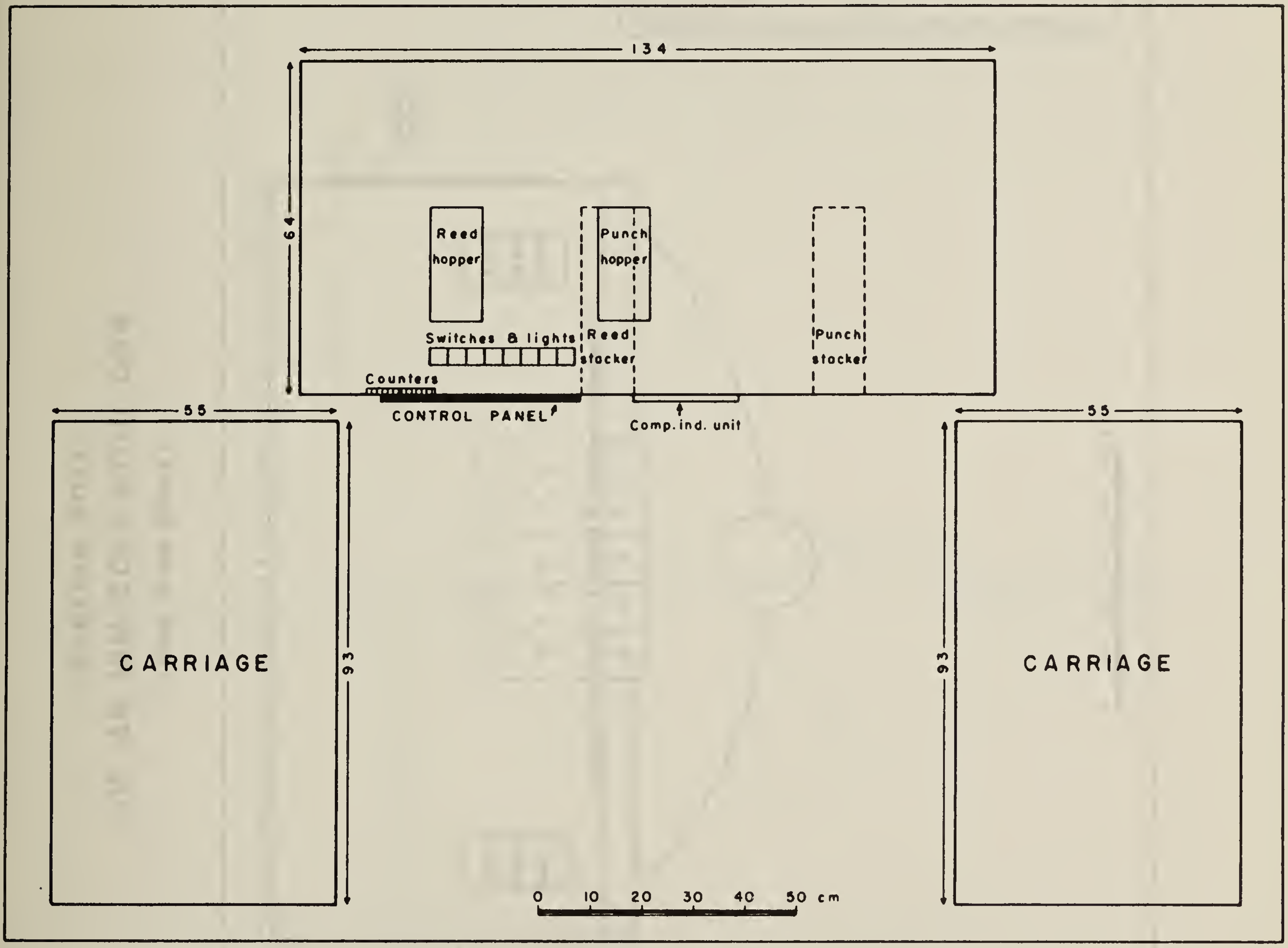


WORKING POST
OF AN IBM COLLATOR 077

(View from above)

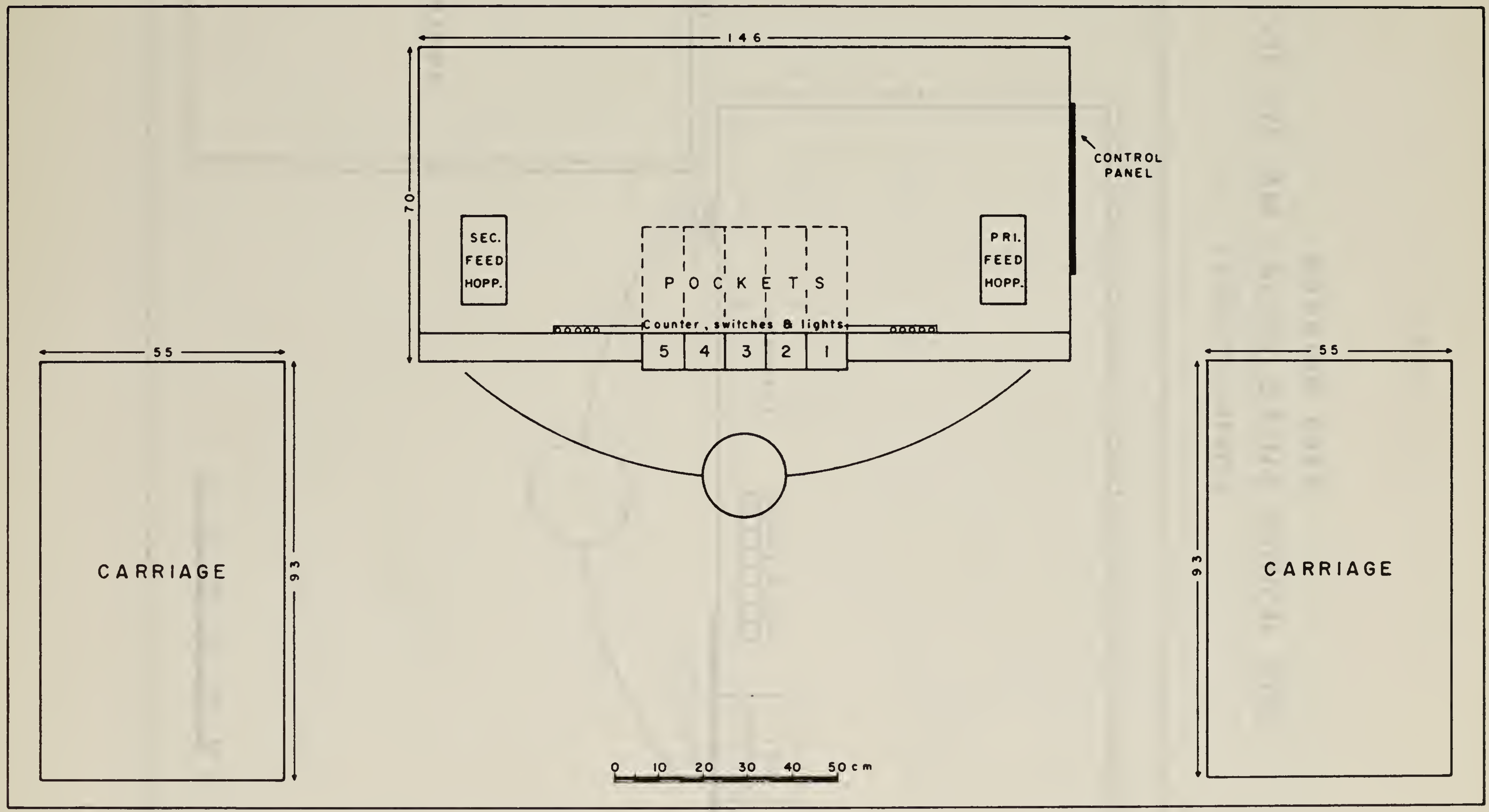


WORKING POST
OF AN IBM REPRODUCING PUNCH 519
(View from above)

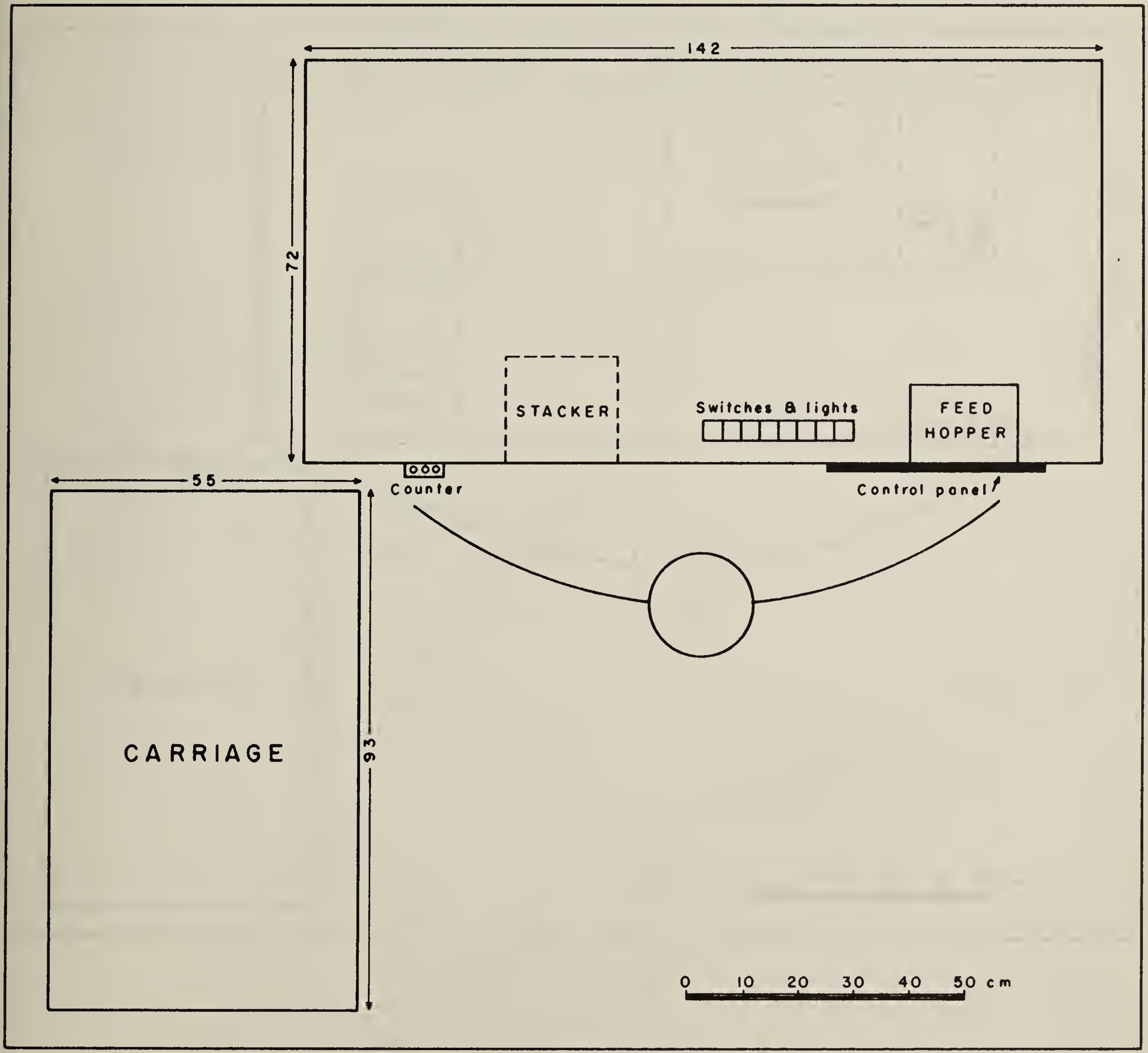


WORKING POST
OF AN IBM COLLATOR 088

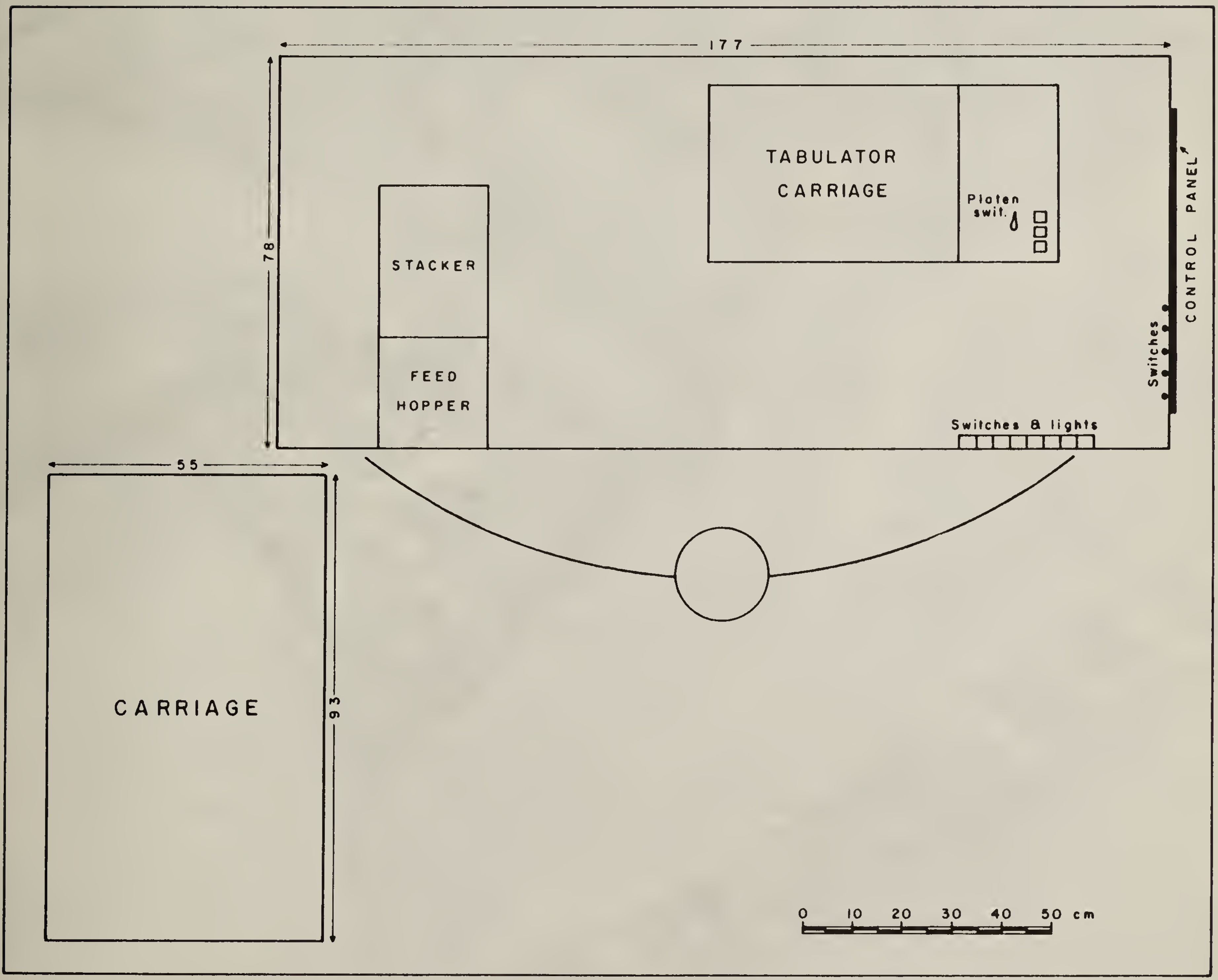
(View from above)



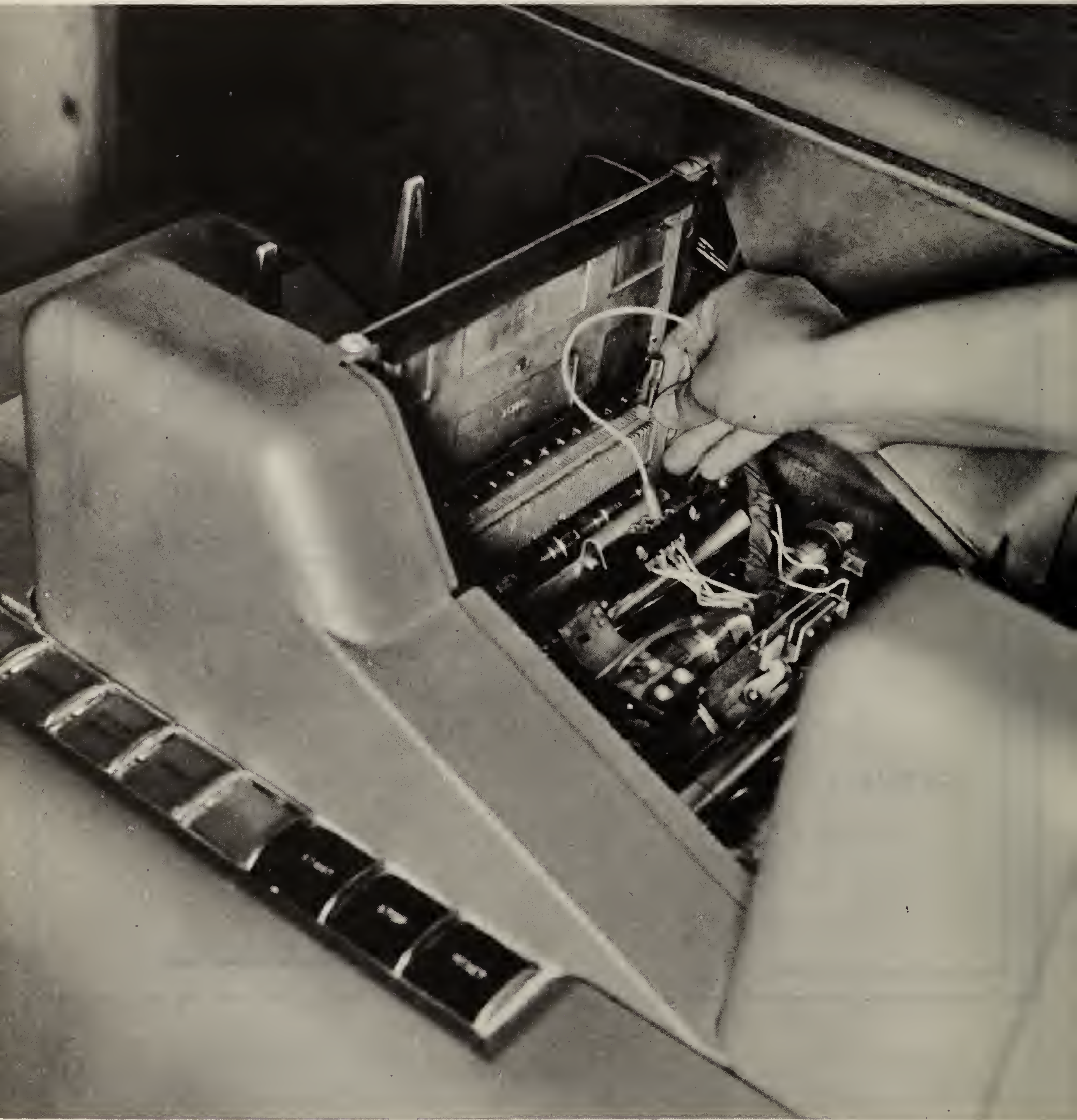
WORKING POST
OF AN IBM CALCULATING PUNCH 602
(View from above)



WORKING POST
OF AN IBM ACCOUNTING MACHINE 407
(View from above)



IBM 519 BRUSH ADJUSTMENT



IBM REPRODUCING PUNCH 519 - BRUSH ADJUSTMENT

Method of Construction:

Seventeen holes were made in a metal strip and in each of them a small pin was inserted (making a raised index) to represent division into fifths of the columns. At each edge of the metal strip two holes were left open for connecting the strip to the machine. In the machine, above the regular index, are two holes in which screws can be inserted to connect the raised index to the machine.

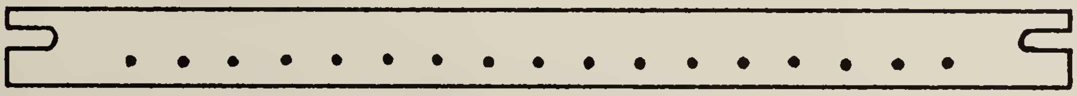


Diagram of a Raised Index

Method of Instruction:

1. Hold x brush holder.
2. Move it to the raised index.
3. With finger, count the pins from the beginning.
4. Insert x brush holder under a pin.
5. Check that x brush holder index is parallel to the pin.
6. Remove x brush holder slowly from its position.
7. Move x brush holder to the left or right parallel to the index, while counting the clicks.
8. Insert x brush holder in the required position.
9. Fasten the screw tightly.

[illegible]

[illegible]

[illegible]

[illegible]

JAM REMOVING

ALPHABETIC INTERPRETER 557

1. Switch off main switch.
2. Remove cards from hopper.
3. Open upper right cover.
4. Grasp type handle.
5. Pull type handle until it stops.
6. Move hand from bottom to top to find jammed card.
7. Grasp the jammed card on its larger protruding side.
8. Remove it carefully.
9. Grasp type block handle
10. Pull it downward.
11. Push type block until it stops.
12. Raise handle to lock the type block.
13. Open upper left cover.
14. Move hand from right to left to find jammed card.
15. Hold the jammed card on its larger protruding side.
16. Remove jammed card
17. Put hand into the right stacker.
18. See if there is another jammed card on the flat head.
19. Put hand into left stacker.
20. Look for jammed card.
21. Close left upper cover.
22. Close right upper cover.

N.B. Check if the position of the row-wheel has not been changed while removing jam.

COLLATOR 077

1. Switch off main switch
2. Remove cards from the primary hopper
3. See if there is a jammed card
4. Open upper cover
5. Pull front cover upward, using both hands
6. Put it aside.
7. Grasp brushes block release lever with left hand.
8. Pull brushes block release lever to the right.
9. Move hand from right to left to find jammed card.
10. Hold the jammed card on its larger protruding side and pull it out.

N.B. If it is difficult to remove the jammed card from the hopper, open the cover.

11. Put hand in the left side of brushes block in an upward direction to see if there is a jammed card.
12. Grasp brushes block with both hands.
13. Push it upwards
14. Push brushes block release lever to the left.
15. Replace front cover.
16. Remove cards from the secondary hopper.
17. See if there is a jammed card.
18. Push brushes block release lever to the right.
19. Raise brushes block arrow handle until it stops.
20. Put hand between rollers.

21. See if there is a jammed card.

22. Grasp the jammed card on its larger protruding side and pull it out.

23. Pull down brushes block release lever.

24. Turn it to the left while keeping it pressed down until it locks.

25. Move hand from right to left to see if there is a jammed card between the chute blade rollers.

26. Hold jammed card on its larger protruding side and pull it out

27. Close upper cover.

N.B. After completing task, switch on main switch and put a test card through to ensure that everything is in order.

REPRODUCING PUNCH 519

1. Switch off main switch.
2. Remove cards from the hoppers and stackers.
3. Open upper cover.
4. Open front cover.
5. Remove waste box.
6. Grasp dies spring handles.
7. Pull them towards each other, and then down.
8. See if there is a jammed card inside, between the punch and dies.
9. Hold the jammed card on the larger protruding side and remove it carefully.
10. Pull the catch towards the center.
11. Grasp dies spring handles.
12. Push the dies upwards in their grooves until they click.
13. Pull the handles apart.
14. Remove the following brushes: comparing, reproducing and gang punch, one after the other as follows:-

    i) Grasp the two handles at the side of the brushes.

    ii) Pull them towards each other and then down.

    iii) See if there is a jammed card between the brushes.

15. To re-insert the brushes:-

    i) Push the handles towards each other and then up, until a click is heard.

    ii) Grasp brushes spring handles, pull towards each other.

iii) Switch on main switch (switch on machine).

iv) Press clutch knob.

v) Push the start key with left hand, and simultaneously push the brushes upward until a second click is heard.

16. Replace waste box.

17. Close front cover.

18. Close upper cover.

COLLATOR 088

CHECK

1. Remove cards from the primary hopper.

2. Remove the jammed card from the primary hopper.

3. Press runout key.

4. Correct the jammed card.

5. Put the two cards from the first stacker into the hopper.

6. Put the corrected card into the hopper.

7. Replace the cards removed from the hopper.

8. Press start key.

N.B. The same procedure should be followed with the secondary hopper.

JAM

An indication of a jam is when the "transport" signal lights up.

1. Pull both file feeds away from the center (as in the Sorter).

2. Raise joggling plate.

3. Push upper cover away from you.

4. Move hand from right to left to see if there is a jammed card.

5. Remove brushes by pressing spring holder of brushes block to see if there is a jammed card inside.

6. Replace brushes holder - ensure that the spring axis is properly in place.

7. Place hand in stackers to see if there is a jammed card.

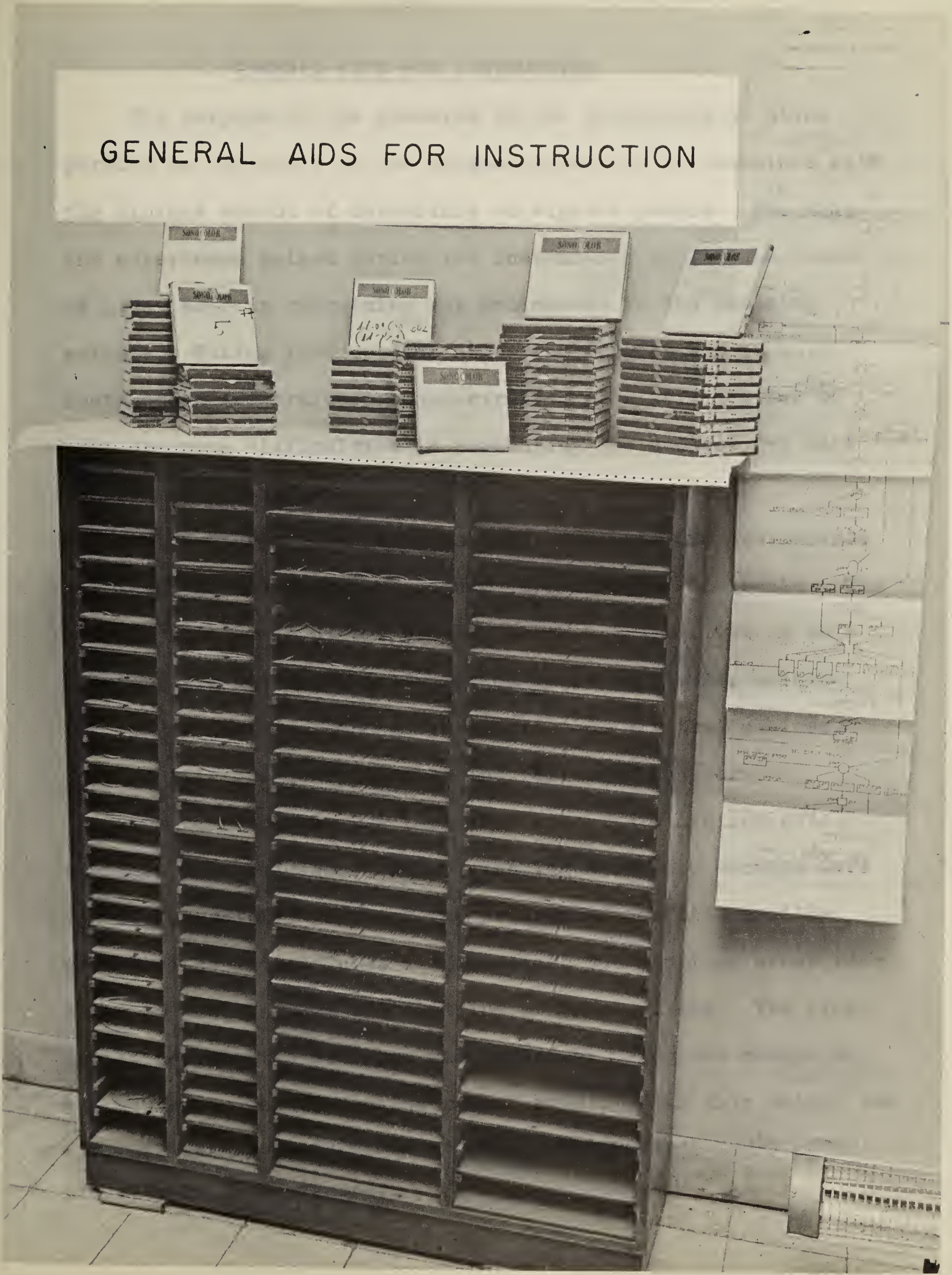
N.B. Do not remove second set of brushes before replacing first.

CALCULATING PUNCH 602

1. Switch off main switch
2. Open upper cover
3. Grasp the two knobs at the side of the control x brushes (next to the feed).
4. Pull them towards each other
5. Raise the control x brushes
6. See if there is a jammed card above the roller which is under the control x brushes.
7. Grasp the jammed card on the larger protruding side and remove it carefully.
8. Insert the control x brushes by pushing the knobs towards each other and then down. (Make sure that the axes of the knobs are in their holes).
9. Do the same with the reading brushes but instead of raising them, push them away from you, and instead of pressing them down, pull them towards you.
10. Open front cover (above panel)
11. Loosen three screws and remove the metal plate.
12. See if there is a jammed card under the plate.
13. Remove the jammed card or move it to the left with finger.
14. Replace the plate and fasten screws.
15. On the left of the plate is another plate which is fastened with only one screw, which protrudes. Do the same with this plate as with the first.
16. Close front cover.
17. Close upper cover.
18. Switch on main switch.

ACCOUNTING MACHINE 407

1. Switch off main switch
2. Remove cards from the feed hopper
3. Remove cards from the stacker
4. Stand at the left side of the machine
5. Raise the upper cover (stacker cover)
6. Press stacker lock
7. Raise stacker lock and move it to the left
8. Raise brush holder and move it to the right
9. See if there is a jammed card.
10. Take out jammed card.
11. Lower brushes holder
12. Keep brushes holder pressed down
13. Lower card holder
14. Press it down till it clicks
15. Close upper cover.
16. Switch on main switch.


GENERAL AIDS FOR INSTRUCTION
SONOCOLOR
SONOCOLOR
SONOCOLOR
SONOCOLOR
SONOCOLOR
SONOCOLOR

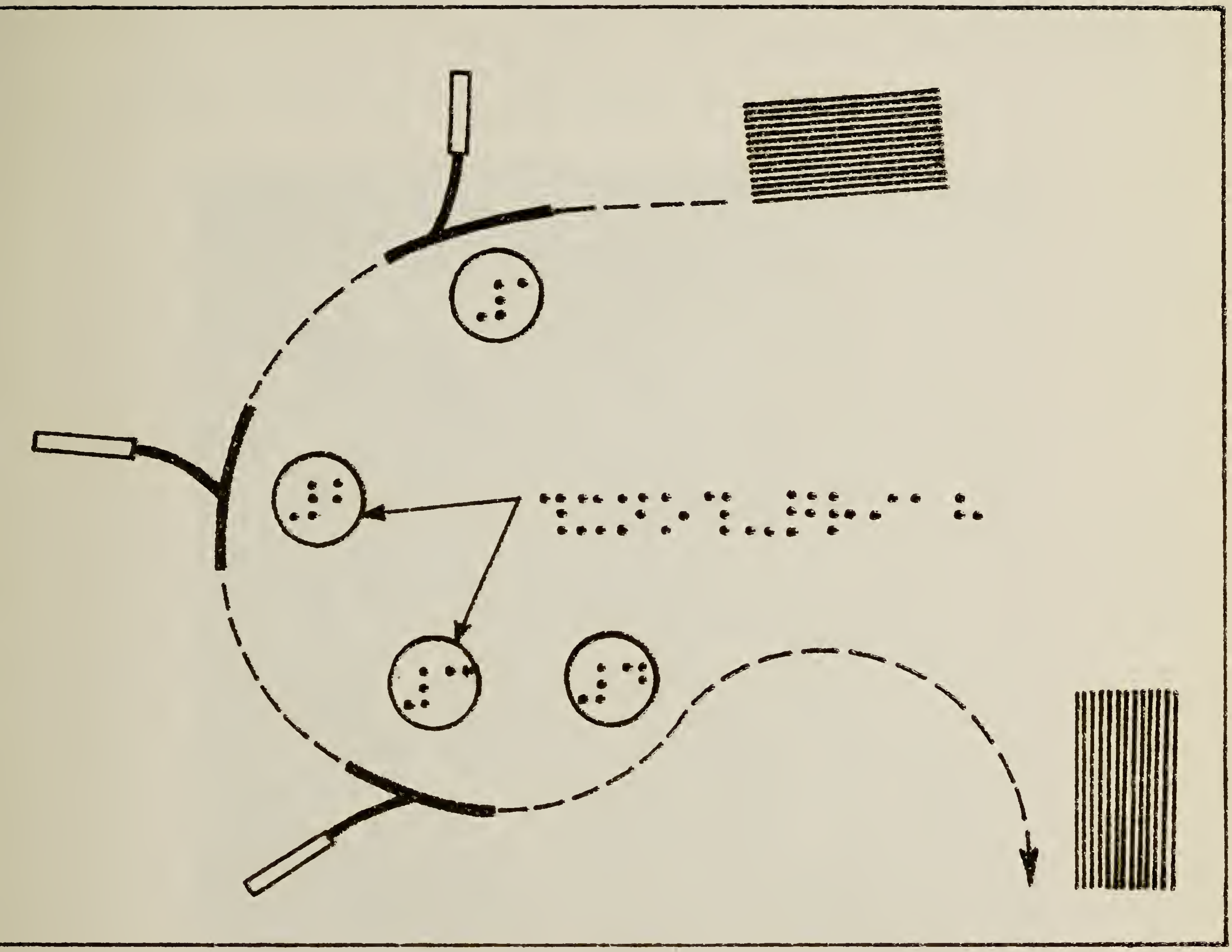
GENERAL AIDS FOR INSTRUCTION

The purpose of the research is the graduating of blind persons as operators of the maximum number of IBM machines with the minimum amount of dependency on sighted people. For this the experience gained during the instruction period was found of great help in overcoming any weaknesses in the teaching methods. Taking into consideration the suggestions of both instructors and trainees, demonstration aids were devised to help overcome difficulties in presenting the subject and make comprehension easier.

Multi-sensory aids such as auxiliary aids and instruments for teaching and work performance were designed and built. The General Aids built at the Center, which are described in this chapter, are not necessarily for only one particular machine but can be used for general instruction on all the machines. Special Aids are dealt with in the following chapter.

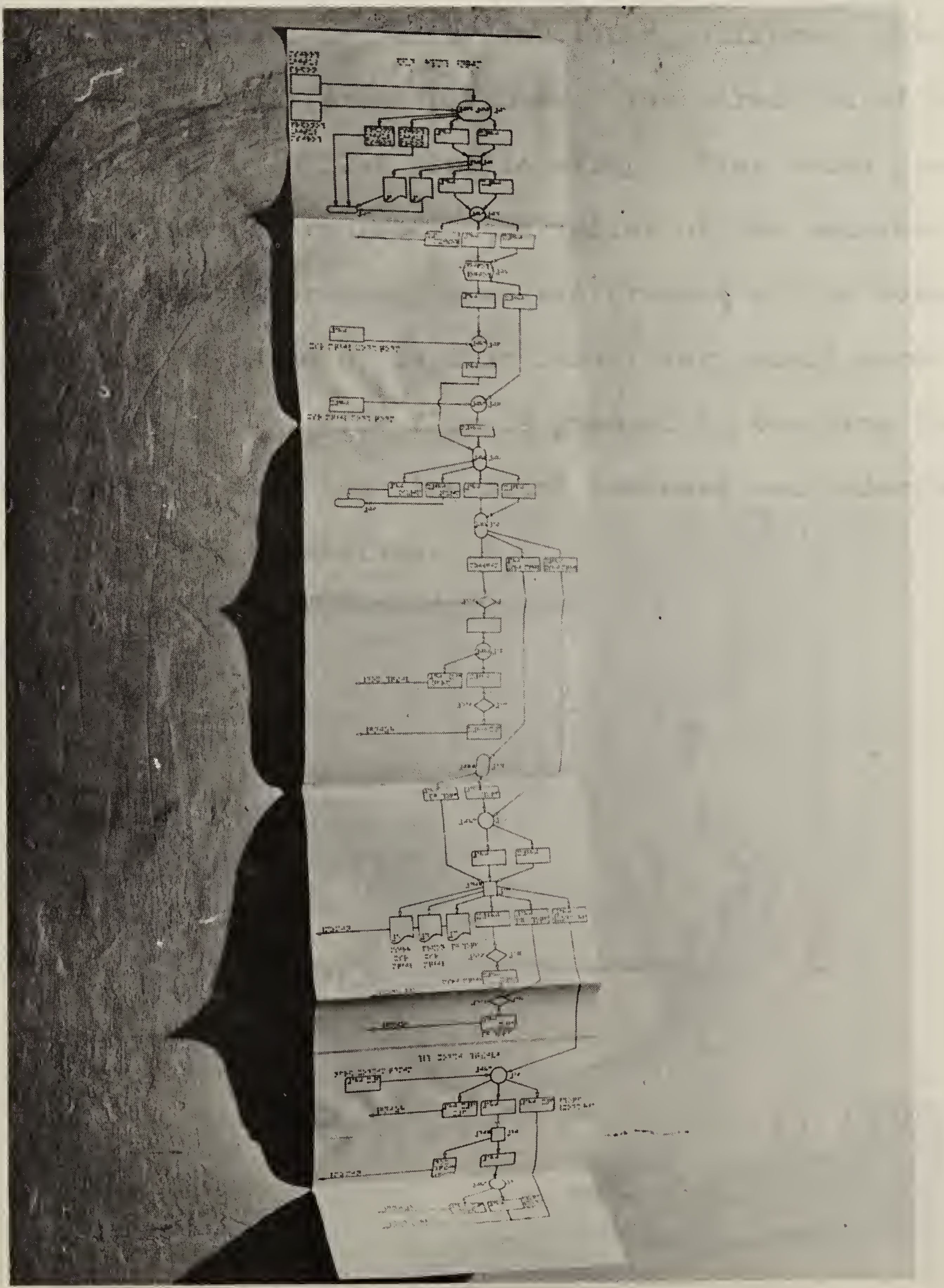
In order to make the technical literature available to trainees and graduates, the Originating Reference Manuals were copied in braille. Copying the printed matter into braille presented no indissoluble difficulties, but problems arose relating to the diagrams and examples of panel wiring. The problem of copying the diagrams was solved by using the method of the Gestetner Co. for making raised print. With this method the diagrams were made tangible and thus the trainees could grasp the subject (See example).

EXAMPLE OF RAISED DIAGRAM

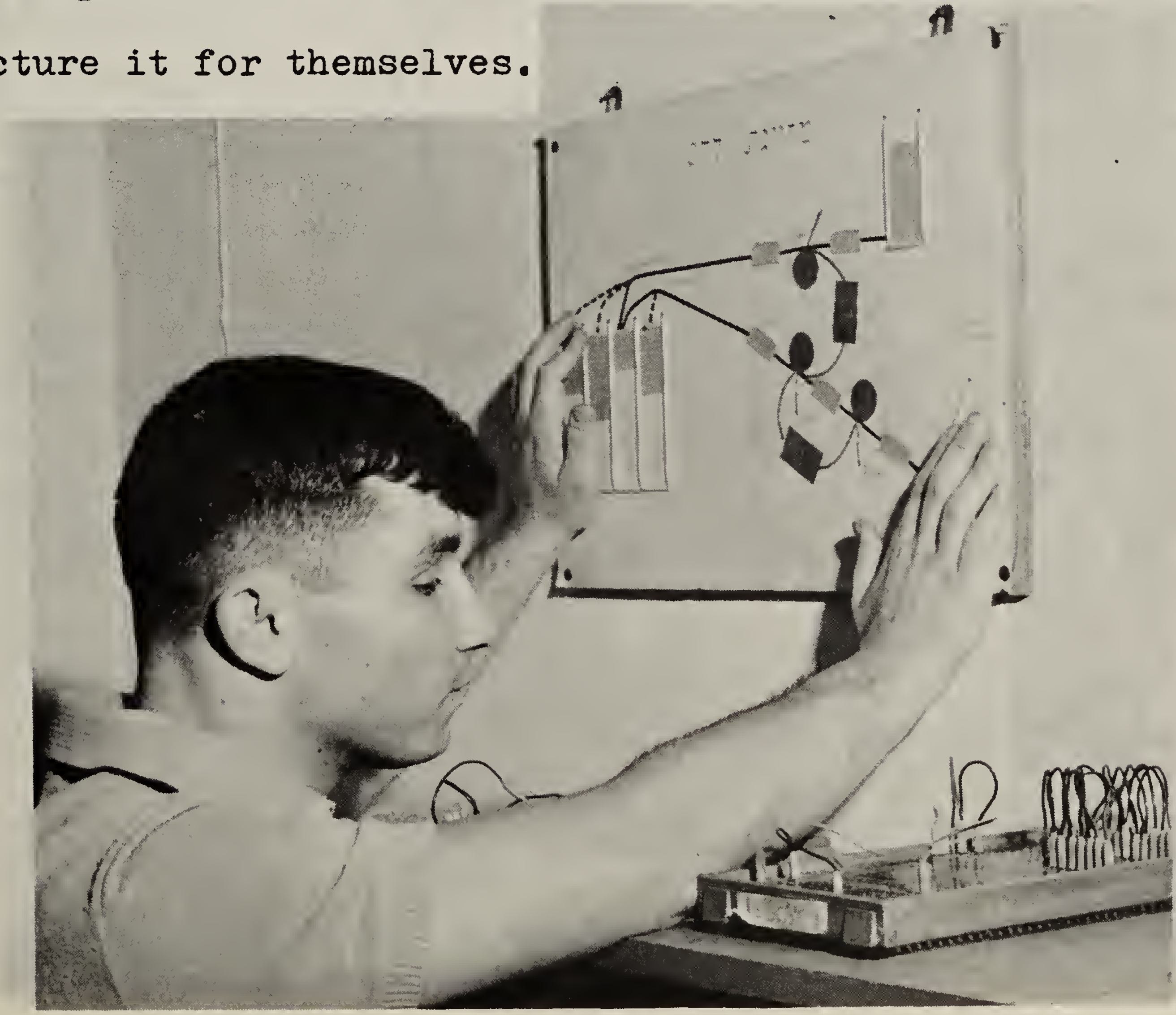


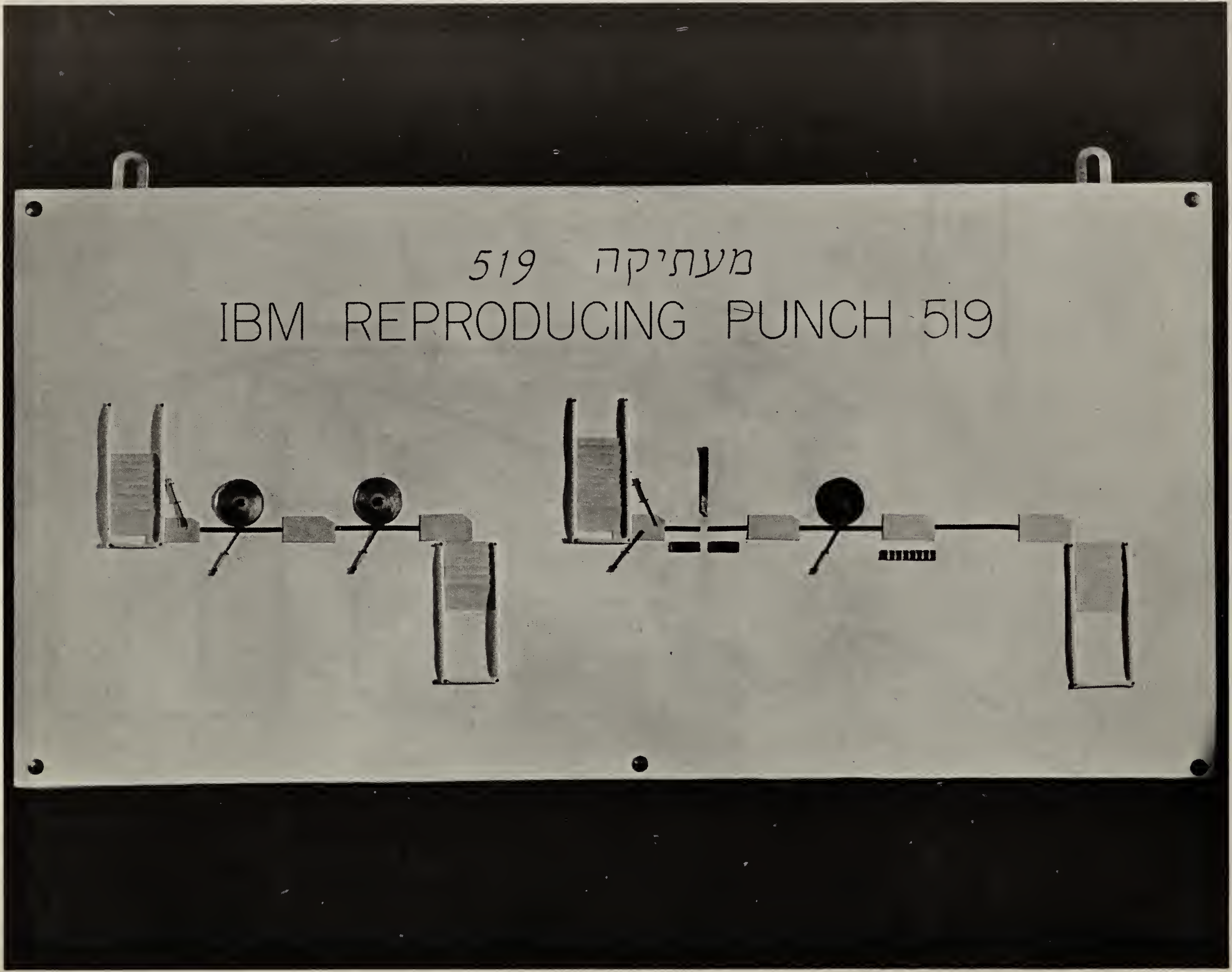
REPRODUCED ON THE GESTETNER
FROM GESTEFAX STENCILS

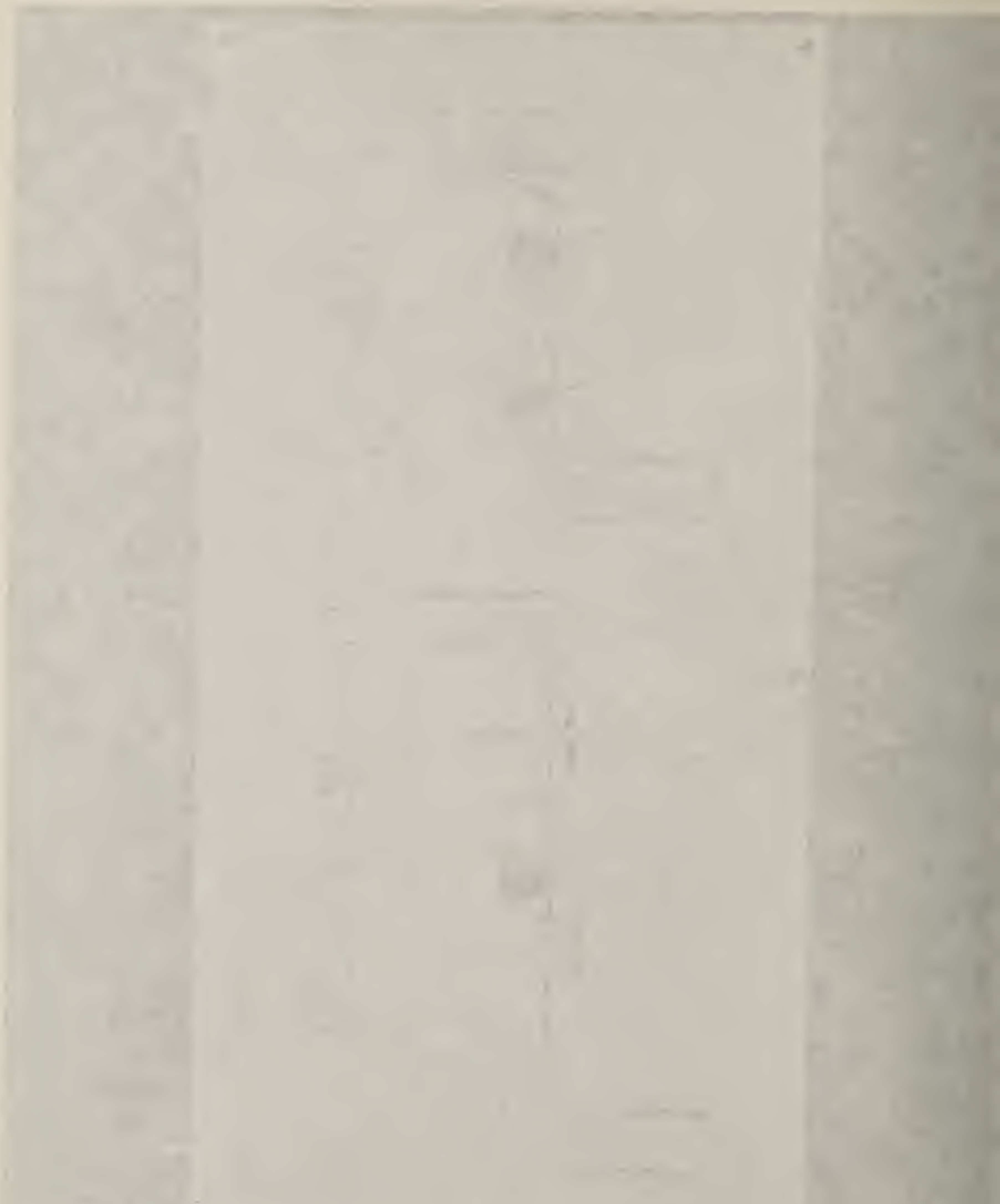
This method of explaining diagrams to the blind was thoroughly explored and a raised flow chart of a job was built accordingly which enabled the blind to follow lectures on the subject in the IBM system (see illustration).

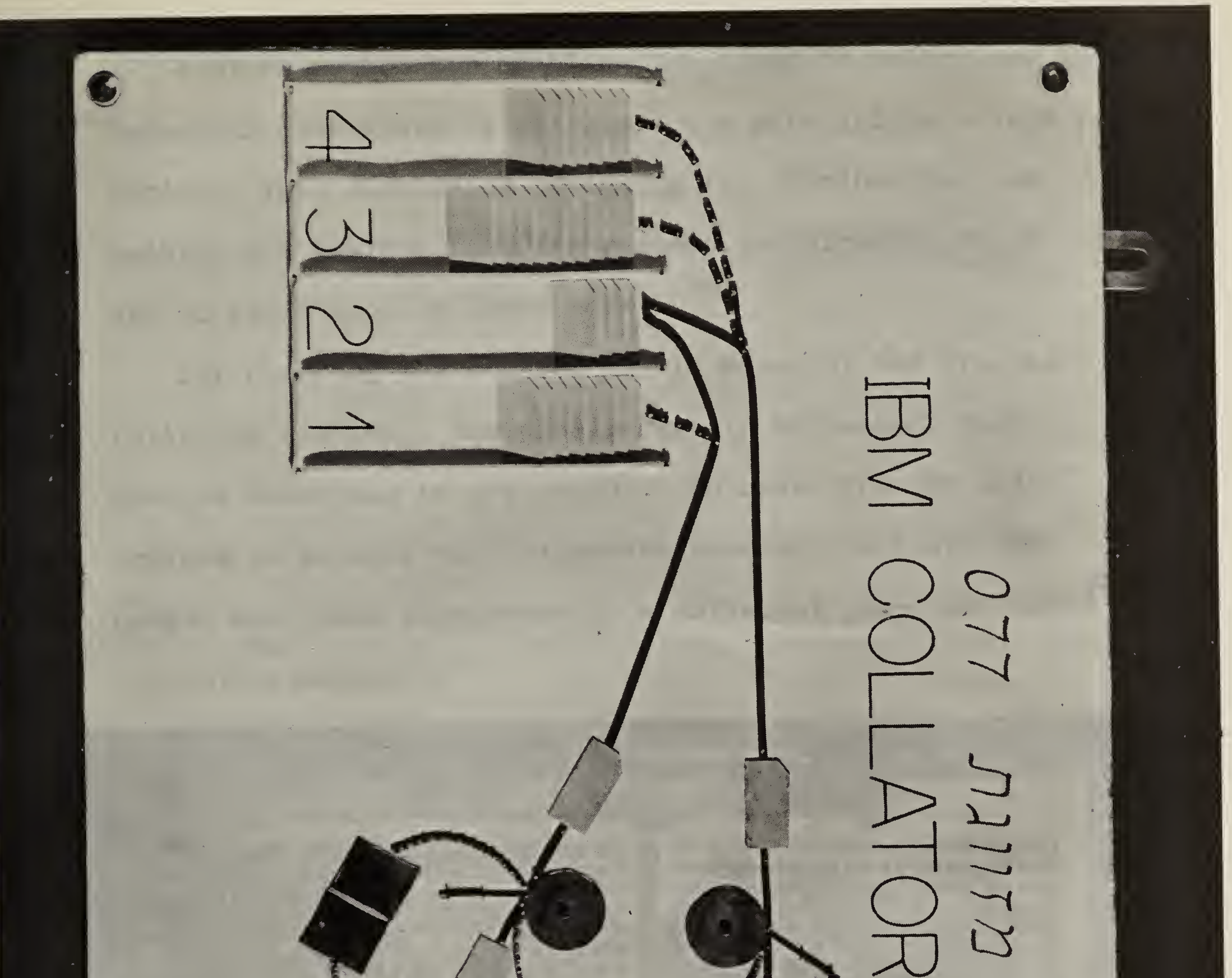


Of special concern were the diagrams showing the work stations in the machines and the process of the flow of the cards between stations. These diagrams were built as follows: A wooden board was covered with paper on which was drawn, magnified, the work stations of the machines. In order to explain the components and their functions, different materials were used for different purposes. The direction of the flow was depicted by a flat plastic strip. Flat round pieces of metal were used to represent the roller of the machine- in place of the reading brushes, standard brushes of the Sorter were used, and in place of regular cards, very small cards (See following ill.) . The flow is grasped by touching the different parts: from this the blind students can understand and picture it for themselves.



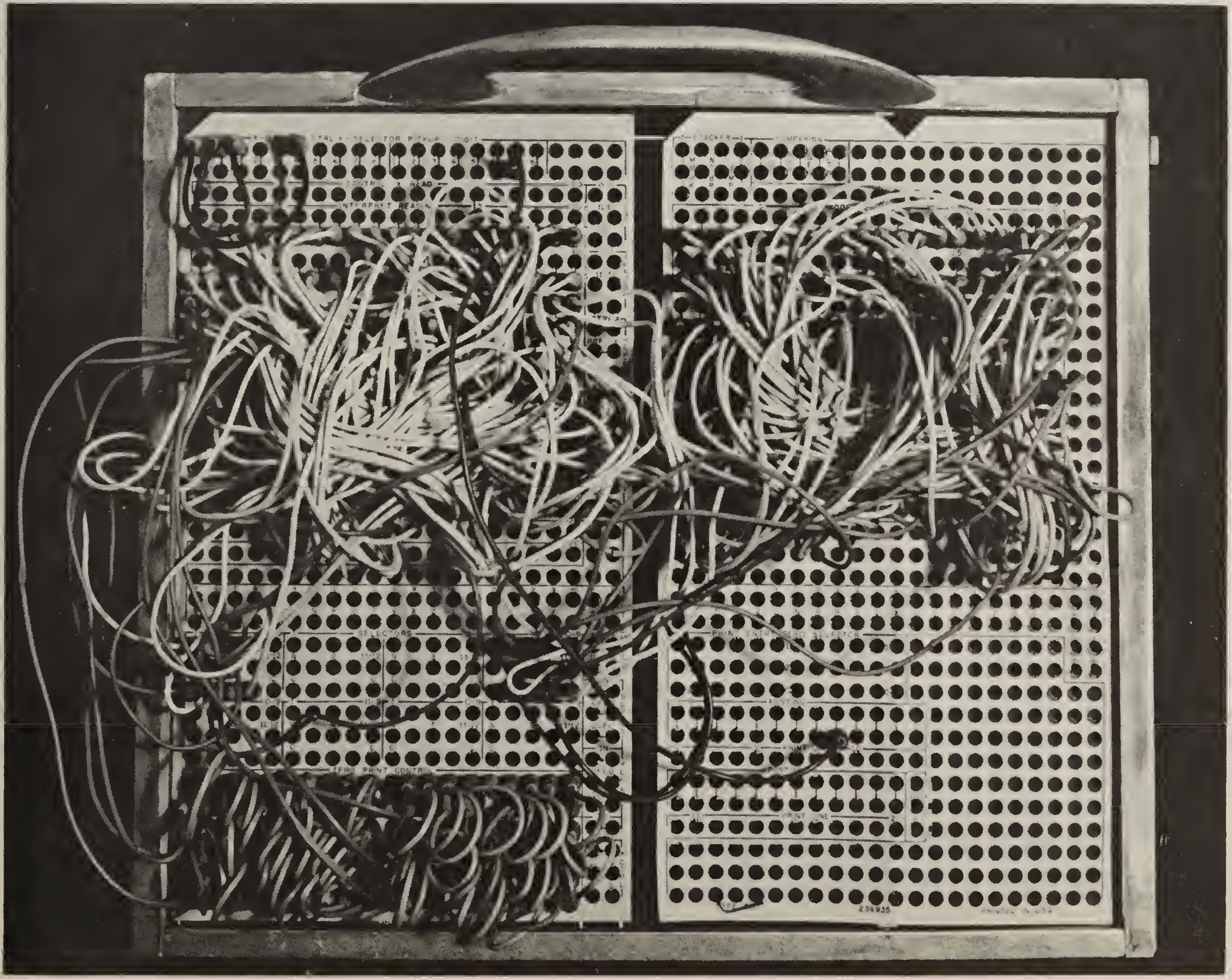

מעתיקה 519
IBM REPRODUCING PUNCH 519

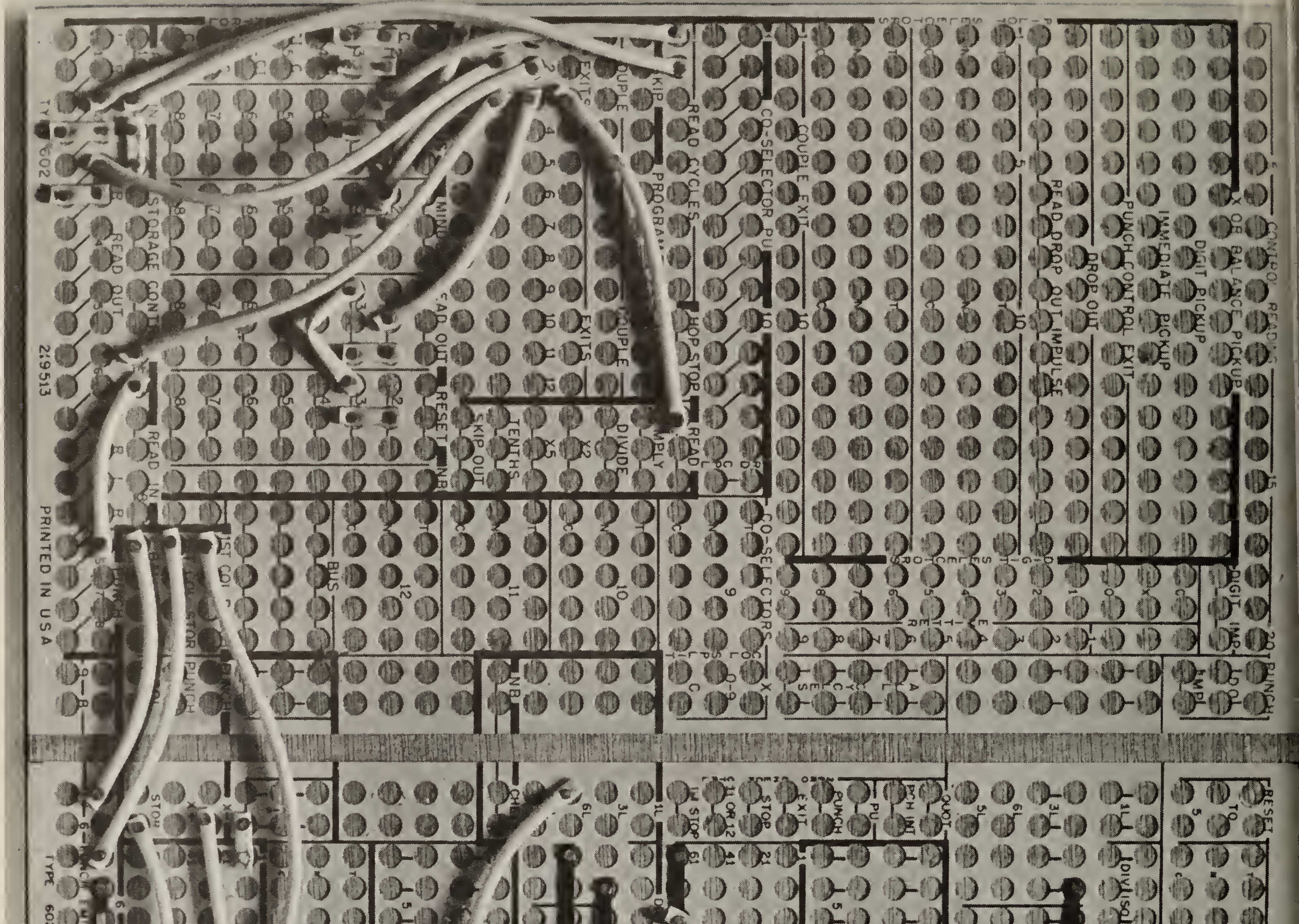



IBM COLLATOR 077
077 COLLATOR

Another method for enabling the blind to understand the technical literature is to record the material on a tape recorder. This simplifies reviewing for examinations and enables the trainee to write resumes for himself, which are of assistance in later work.

For checking the control panels wired by the trainee (blind or sighted), the panels have to be masked, each machine according to its layout. In order for the blind trainee to be able to distinguish between the different masks, each mask is notched in a different place or places (see illustration).




CONTROL READING
DIGIT PICKUP
X OR BALANCE PICKUP
IMMEDIATE PICKUP
PUNCH CONTROL EXIT
DROP OUT
READ DROP OUT IMPULSE
DIGIT IMP.
20TH PUNCH
SELECTORS
CO-SELECTORS
COUPLE EXIT
CO-SELECTOR PU
READ CYCLES
SKIP
PROGRAM
COUPLE
EXITS
HOP STOP
READ
MULTIPLY
DIVIDE
X2
X5
TENTHS
SKIP OUT
READ OUT
RESET
STORAGE CONTROL
READ IN
BUS
1ST COL
STOR PUNCH
PUNCH
2:9513
TYPE 602
PRINTED IN USA
RESET
DIVISOR-MULTIPLIER
STORAGE TRANSFER EXIT
COUNTER ENTRY
DIVIDEND
READING
STORAGE ENTRY
COUNTER EXIT
QUOT.
PUNCH
STOP
EXIT
PUNCHING
PUNCH EXIT
2:9514
TYPE 602 A
PRINTED IN USA

WIRING PANEL MODEL

Method of Construction:

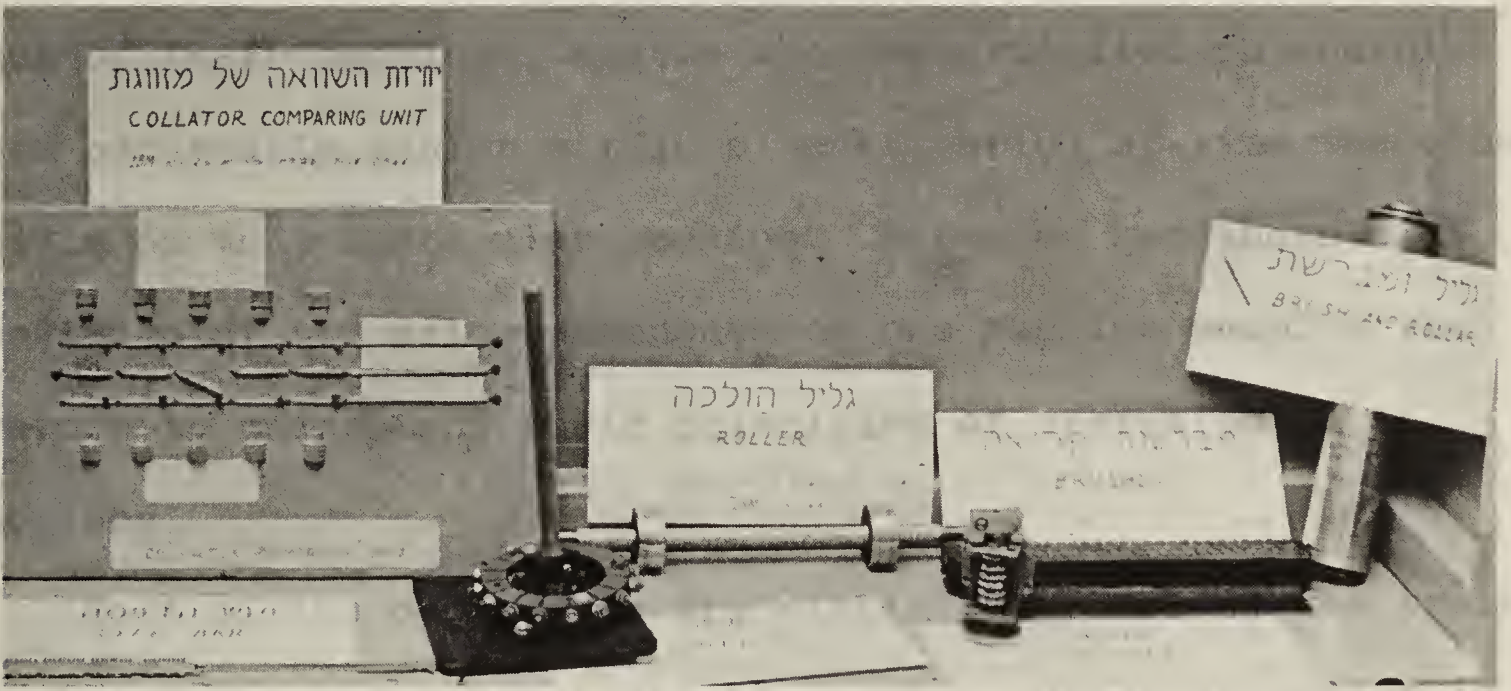
On an ordinary wooden board of the size of a standard panel masks were glued according to the examples given in the Originating Reference Manuals.

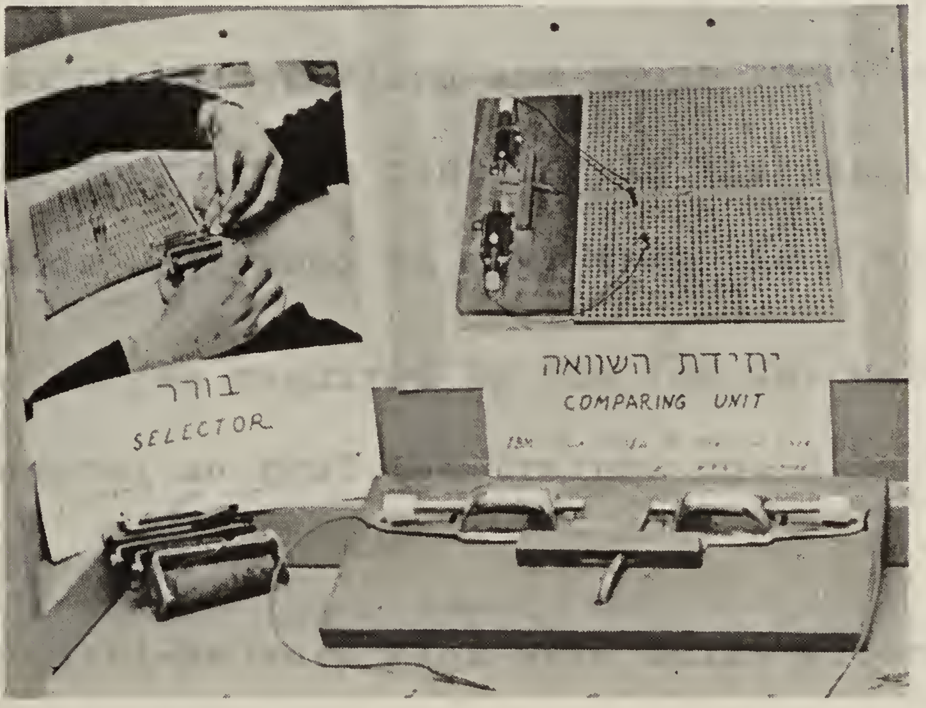
Jack plugs were represented by short strips of plastic tubing and fields by a flat plastic strip. Connection from one hole to another is represented by a length of plastic tubing. Should the connection be from field to field, then the tubing is connected from the center of one field to the center of the other.

Method of Instruction:

The student feels the panel, finds the end of a strip and counts the holes vertically ahd horizontally (coordinates) up to the end of the strip; he follows its length till the second point of connection. In this way he learns how the model panel is connected. He can also feel the jack plugs and the fields.

SPECIAL AIDS FOR INSTRUCTION





SPECIAL AIDS FOR INSTRUCTION

The series of machines on which the research is conducted is usually a complete system, on which it is possible to execute all the operations relating to automatic data processing.

Although the IBM Co. constantly produces new models of each of their machines, anyone who has graduated on one of them can easily master within a short period of time the other models of that particular machine. Research has shown that knowledge of the main components of one machine enables the trainee to understand their principles of operation in all machines.

Most of the components are within the reach of the trainee, but there are several which are not. Given hereunder is a series of illustrations together with explanations of those parts which cannot be described and whose functions cannot be explained while they are in position in the machine. Two alternative methods were used to make them clear to the trainee:-

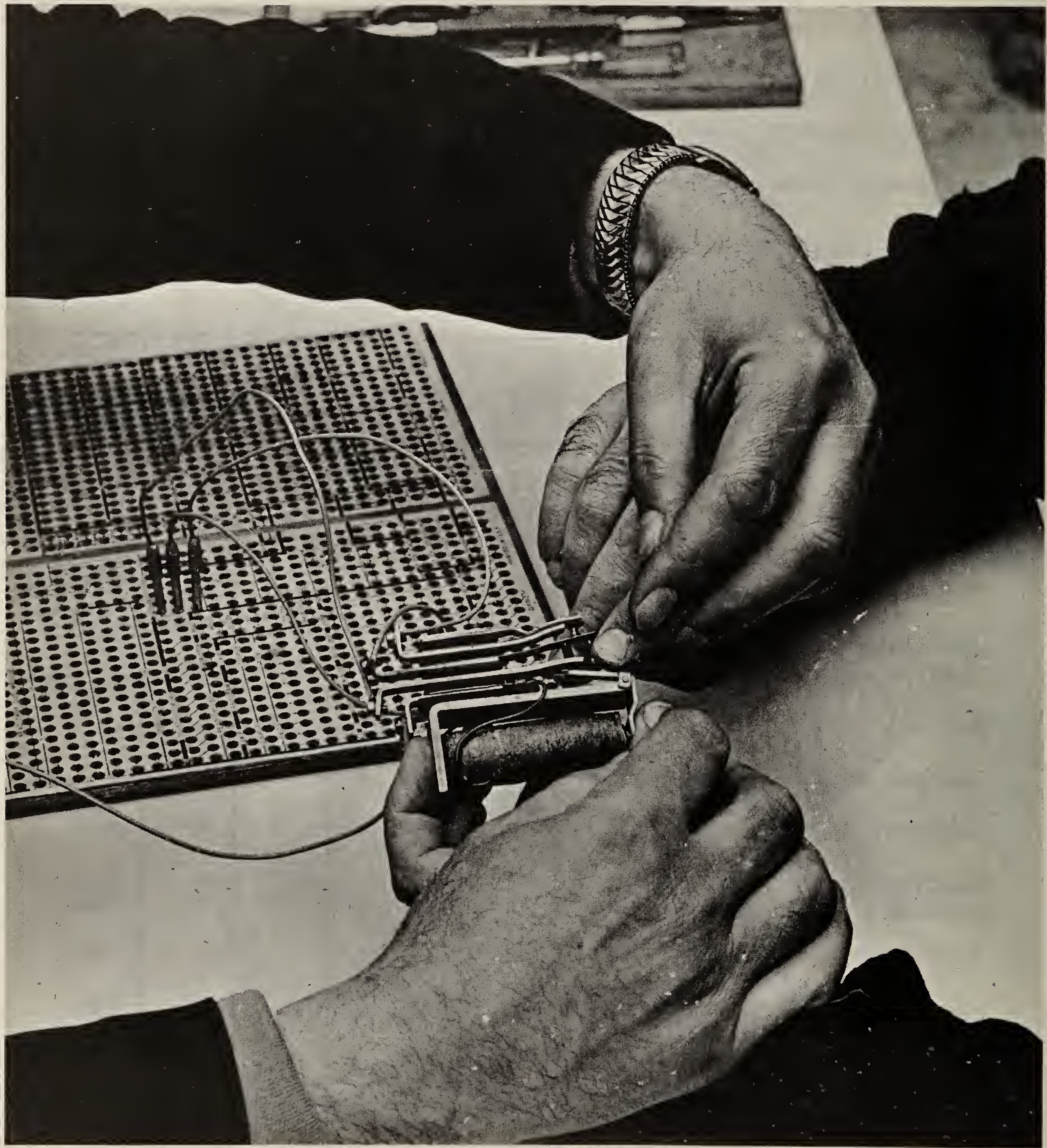
1) Parts no longer required by the IBM Co. were acquired and adapted so that the trainee could be taught how they operate.
2) Special multi-sensory aids were built according to the diagrams appearing in the technical literature or in accordance with the actual components in the machines.

The following is a list of the basic components and their distribution in IBM machines. The column 'Instruction' indicates whether the instructor should use a multi-sensory aid or can demonstrate on the machine.

BASIC COMPONENTS AND THEIR DISTRIBUTION
IN THE MACHINES

Component	Sorter 083	Interp. 557	Repr. 519	Collat.		Cal. Punch 602	Acc. Mach. 407	Instruction
				077	088			
Hopper	x	x	x	x	x	x	x	On Mach.
Feed Unit	x	x	x	x	x	x	x	"
Stacker	x	x	x	x	x	x	x	"
Operating & Control Unit	x	x	x	x	x	x	x	"
Rollers	x	x	x	x	x	x		"
Control Panel		x	x	x	x	x	x	"
Selector		x	x	x	x	x	x	MSA*
Reading Brushes	x	x	x	x	x	x	x	MSA
Type Bars		x	x				x	MSA
Comparing Unit		x	x	x	x		x	MSA
Auxiliary Counters	x	x	x	x	x	x	x	MSA
Emitter		x	x		x	x	x	MSA

*Multi-sensory Aid



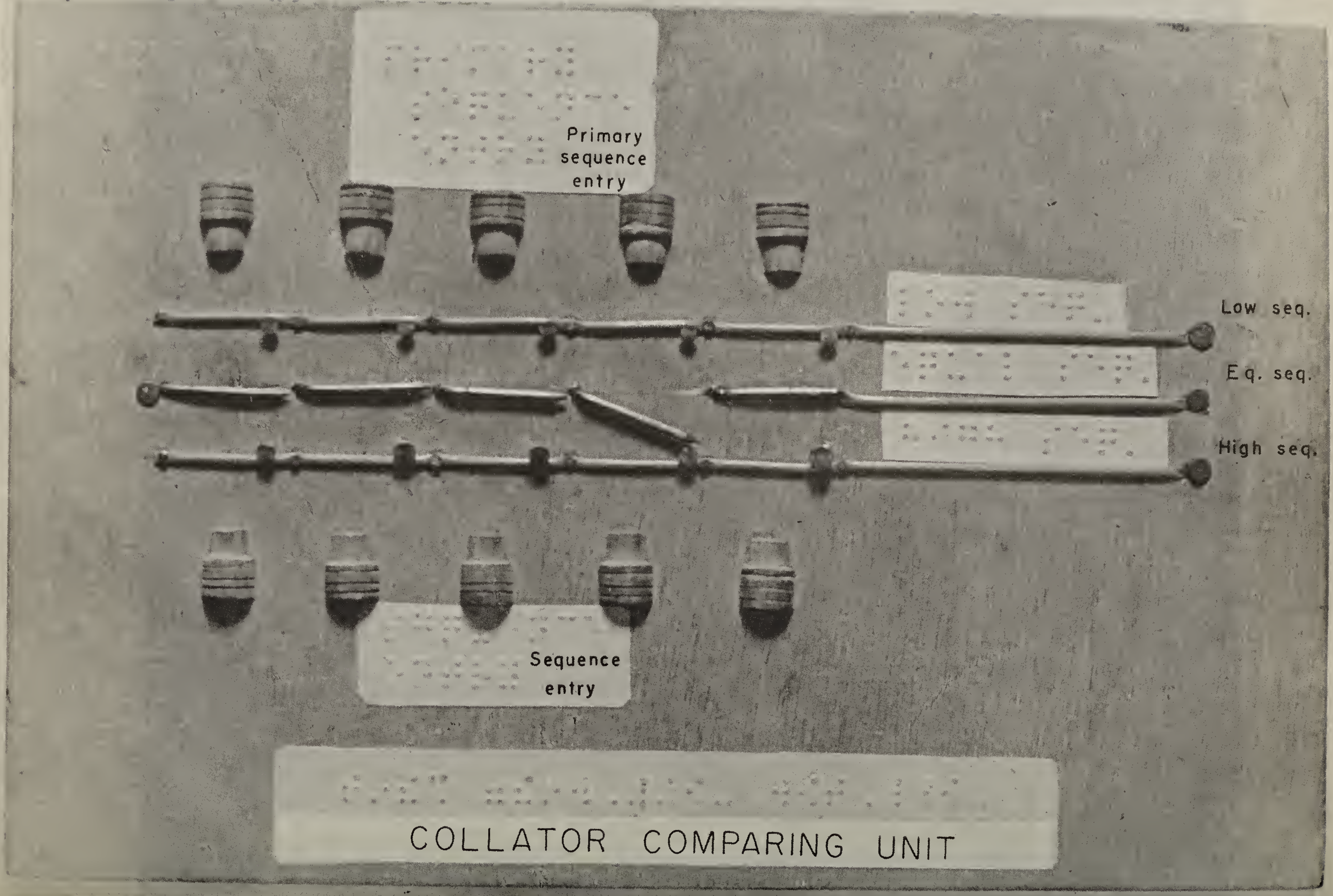
SELECTOR

Method of Construction:

This is a standard IBM part. Some parts were removed from it to create a space between two platinum parts so that the trainee should be able to differentiate between the normal, transfer or common positions created by the impulse current.

Method of Instruction:

The trainee holds the electromagnet of the selector in one hand and presses his finger on the plate, which is magnetized when he receives such an instruction. With his other hand the student feels how the spaces between the platinum parts open and close. He follows the closed circuit with his finger and identifies the manner in which it was created by the plugs in the wiring panel.


Primary sequence entry
Low seq.
Eq. seq.
High seq.
Sequence entry
COLLATOR COMPARING UNIT

COLLATOR COMPARING UNIT

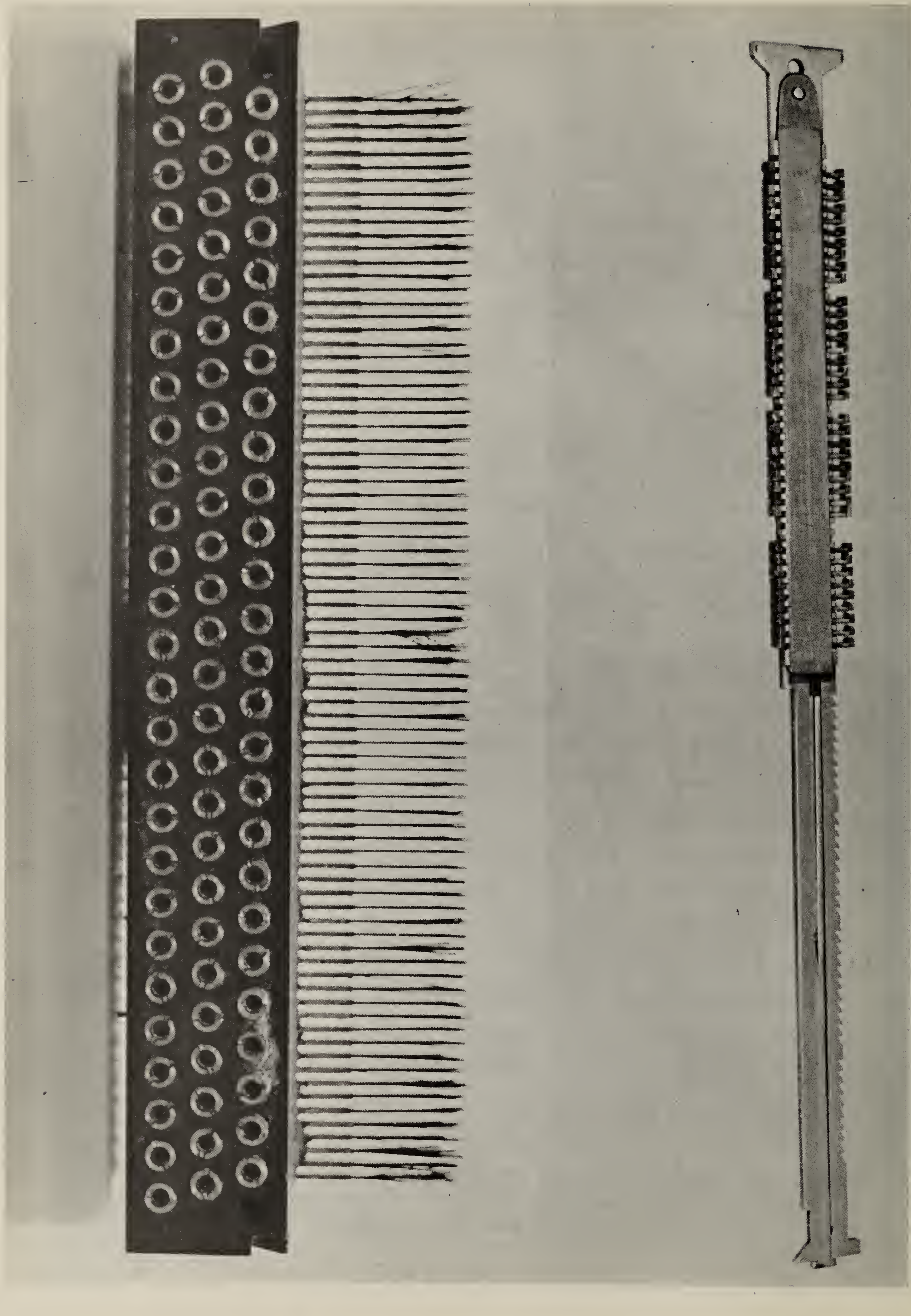
Method of Construction:

On a board are glued two rows of wooden half-rollers which represent electromagnets. Between them, fastened with nails, are two plastic strips, which represent low and high sequence currents. In the center of the strips is a row of nails which protrude from beneath the board and are bent to lie flat; at the end of the row is a short plastic strip. The nails represent equal sequence current; they can be turned to the left or to the right.

Method of Instruction:

1) The trainee passes his hands over the protruding parts in order to obtain a general impression of the form and the dimensions of the model.
2) He places his hands on the 'electromagnets' and reads the braille explanation relating to each row of magnets.
3) He passes his hand over the three current sequences, from left to right.
4) The instructor tells him which 'electromagnet' receives an impulse and the trainee turns the corresponding nail in the direction of that 'electromagnet'.
5) The trainee passes his hand over the nails from the left (the input impulse) of the relative current.

NOTE: The model is based on the illustration of the Collating Comparing Unit which appears in the Functional Wiring Principles, Education Guide R25-1077-2, p.26.



TYPE BAR

Method of Construction:

This is a standard IBM part.

Method of Instruction:

The trainee feels the part, takes note of its length, the division into groups of letters and symbols, the teeth that stop it and the method of pressing the letters during printing. The instructor explains why the letters and symbols are divided into groups and why the teeth that stop it are divided into groups.

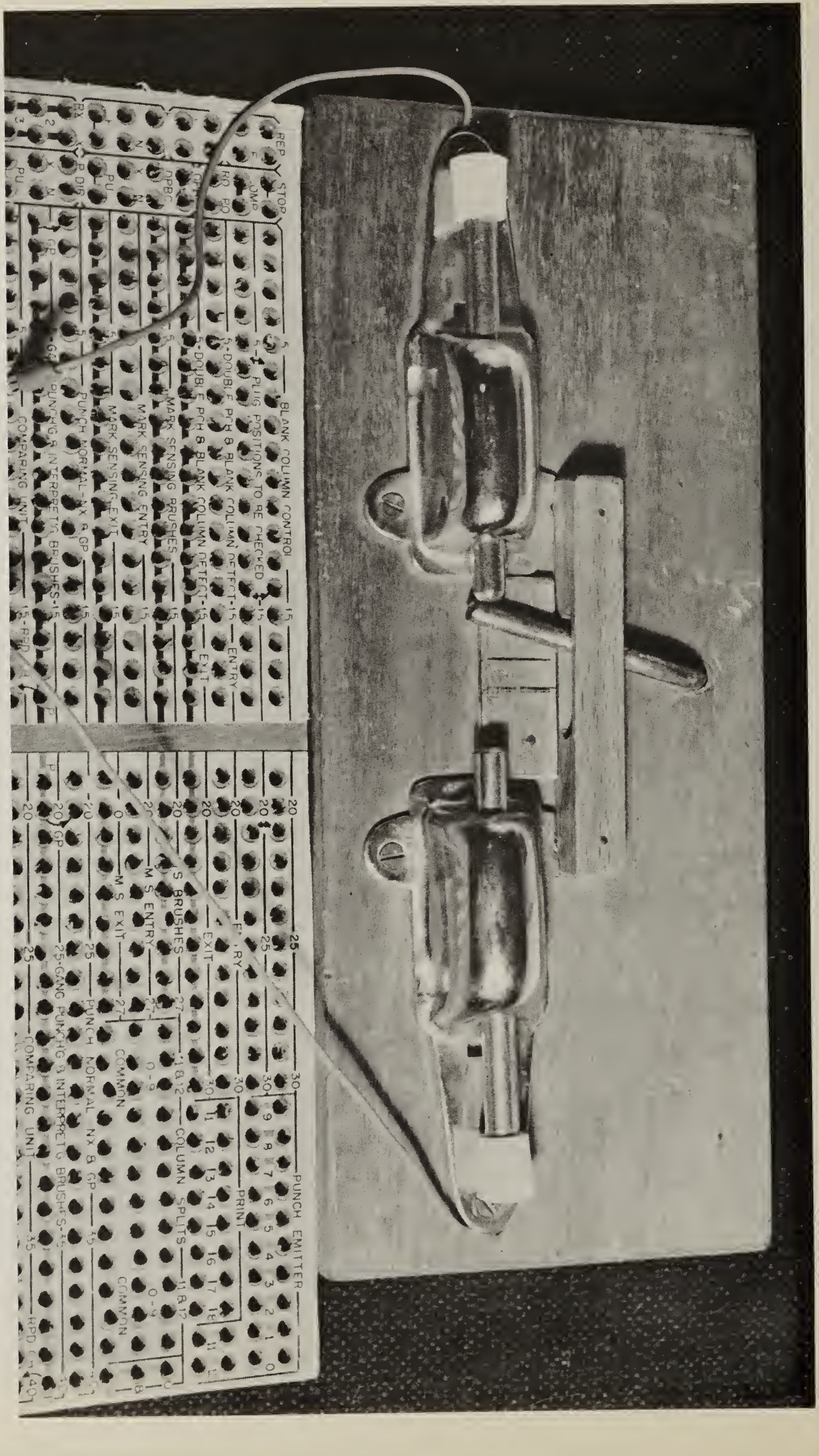
SET OF BRUSHES

Method of Construction:

This is a standard IBM part.

Method of Instruction:

The trainee feels the brushes, their length, the space between them, the material from which they are made and how they are attached to the block.


REP
STOP
COMP
BLANK COLUMN CONTROL
PLUG POSITIONS TO BE CHECKED
DOUBLE PCH & BLANK COLUMN DETECT
ENTRY
EXIT
MARK SENSING BRUSHES
MARK SENSING ENTRY
MARK SENSING EXIT
PUNCH NORMAL NX & GP
PUNCHG & INTERPRETG BRUSHES
COMPARING UNIT
S BRUSHES
M S ENTRY
M S EXIT
25-GANG PUNCHG & INTERPRETG BRUSHES
COMMON
0-9
11 & 12
COLUMN SPLITS
PUNCH EMITTER
PRINT
5
15
20
25
30
35
40

COMPARING UNIT

Method of Construction:

On a board two ordinary doorstops, representing electromagnets, are nailed lengthwise. Between them a magnetized needle is attached, which can be moved freely to the left or right. A control-panel wire ending in a plug is attached to the outside ends of the 'electromagnets'. These can be plugged into a control panel.

Method of Instruction:

1) The plugs are inserted in the control panel.
2) The instructor tells the trainee from which side the impulse comes.
3) The trainee presses the head of the 'electromagnet' (to represent the current) through which the impulse passes. The axis of the 'electromagnet' makes contact with the needle and when it returns to its position the needle adheres to and follows it.
4) The trainee ascertains the situation of the needle with his hand.

00101

COMPARING UNIT

Method of Construction:

On a board two ordinary doorstops, representing electromagnets, are nailed lengthwise. Between them a magnetized needle is attached, which can be moved freely to the left or right. A control-panel wire ending in a plug is attached to the outside ends of the 'electromagnets'. These can be plugged into a control panel.

Method of Instruction:

1) The plugs are inserted in the control panel.
2) The instructor tells the trainee from which side the impulse comes.
3) The trainee presses the head of the 'electromagnet' (to represent the current) through which the impulse passes. The axis of the 'electromagnet' makes contact with the needle and when it returns to its position the needle adheres to and follows it.
4) The trainee ascertains the situation of the needle with his hand.

1 1 2 1 2
0 0 1 0 1
9 9 0 9 0

COUNTER

Method of Construction:

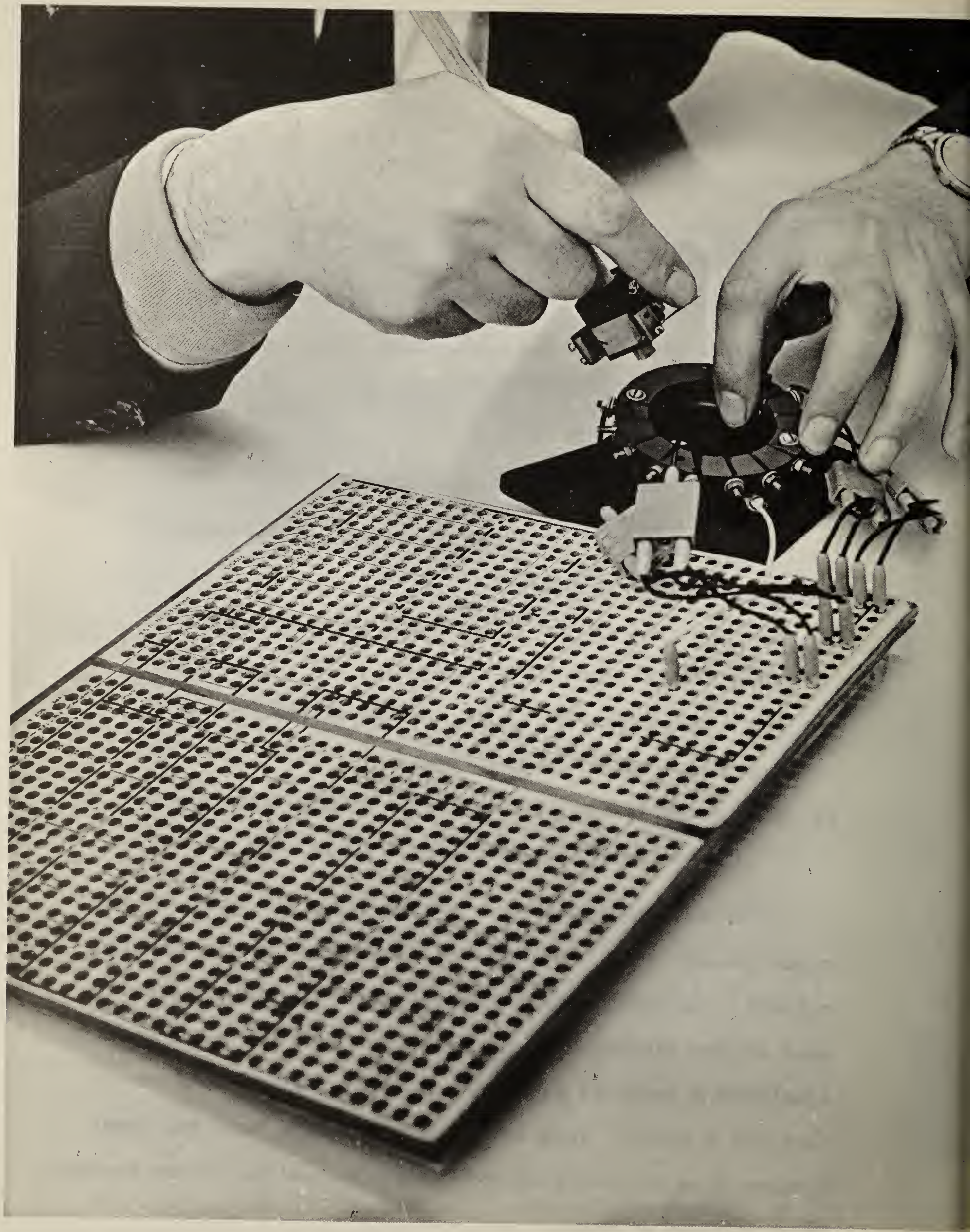
This is a standard IBM part. In order to make it more accessible, the cover was removed. The part is placed on a table.

Method of Instruction:

The instructor explains the operation as follows:

1) As each card goes through the machine it creates a movement of the block.
2) Each movement of the block turns the right numbered roller one-tenth of a cycle.
3) Every ten movements create a complete cycle of the numbered roller on the right.
4) Each complete cycle of the right roller turns the adjacent roller one-tenth of a cycle.

With his right hand the trainee turns the wheel on the right towards him. He places his left hand on the numbered rollers - he listens to the clicks while he feels the movement of the rollers. He can feel that when the right roller completes a cycle it pulls the adjacent roller round one-tenth of a cycle. When the rollers register zero the wheel becomes more difficult to move, thus indicating to the trainee that they are at zero.



EMITTER

Method of Construction:

This is a standard IBM part, in which the following changes were made:-

1) A pivot was fixed into the rotor in place of the roller.
2) Grooves were cut in the stator over the screws.

Method of Instruction:

a) The plugs are inserted in the control panel.

b) The trainee inserts his finger into the stator and feels the internal metal contacts - the projecting ends of the screws (the metal is colder than the material in which it is cast).

c) The trainee feels that each screw is one unit, and that there are 12 units.

d) The trainee feels the metal ring in the stator.

e) The trainee feels the two brushes in the rotor.

The instructor explains that the metal ring is permanently charged with electricity and that the lower brush, being in contact with the metal ring, is also constantly charged with electricity. The upper brush also always has electric current. The rotor turns permanently and sends electric impulses to the 12 contacts in rotation. When the wire which is attached to the external screws is in contact with the control panel the impulse passes through it and creates an operation. When the wire is not attached a circuit is not created, hence there is no action.

FOLLOW-UP

As previously stated, there is no known institute in Israel that teaches the trainees the theory and operation of the machines simultaneously, as is done at the Center. In general it is accepted that the sighted trainee is taught only the theory of the machines. He then knows the functions the machines can perform and he knows how to wire simple control panels, but after this period of study, and even after he receives his certificate, it cannot be certain that he is a good operator.

However, the trainee who completes his studies at the Center acquires as much practice as does a sighted operator after working approximately one year in an installation. During his training, tests are constantly employed which reveal the extent of the trainee's grasp of the subject and his ability to wire panels in complicated combinations. Simultaneously are checked his ability to operate the machines, suitability for the work and working habits. In this way his progress can be ascertained and a decision made as to whether he should continue with his studies or whether changes should be made in the teaching methods.

When undergoing an examination a student generally becomes very tense, which often causes bad work - important details are overlooked and mistakes made. However, after

undergoing repeated tests great improvement is noted in the execution of the work, both in quality and in output. This facilitates the acceptance of outside work by the Center, thus giving practical experience to the students.

The method of checking the execution of the work is as follows: Each student is given a card file covering a particular field; the amount of work required on it is calculated beforehand and a time limit set for its completion.

The first test is held in Sorting. The students then exchange card files, wire panels for the Collator, test the control panels and check the order of the files. The next operation is Interpreting and after that Reproducing. The performance of these operations is dependent on the progress of the students in these subjects, thus it is difficult to stipulate beforehand which of these operations should be executed for the test.

The following test sheet is maintained by the instructor for each trainee:

TEST SHEET

Name of trainee:

Date:

File No.:

Number of Boxes:

Machine No.:

Number of cards at commencement:

Number of Jams:

Number of dropped cards:

Number of cards at end:

Time instructions received:

Time panel-wiring ended:

Time work ended:

Total amount of time for panel-wiring:

Total amount of time for executing work:

Number of cards processed in one hour:

Remarks on panel-wiring:

Remarks on execution of work:

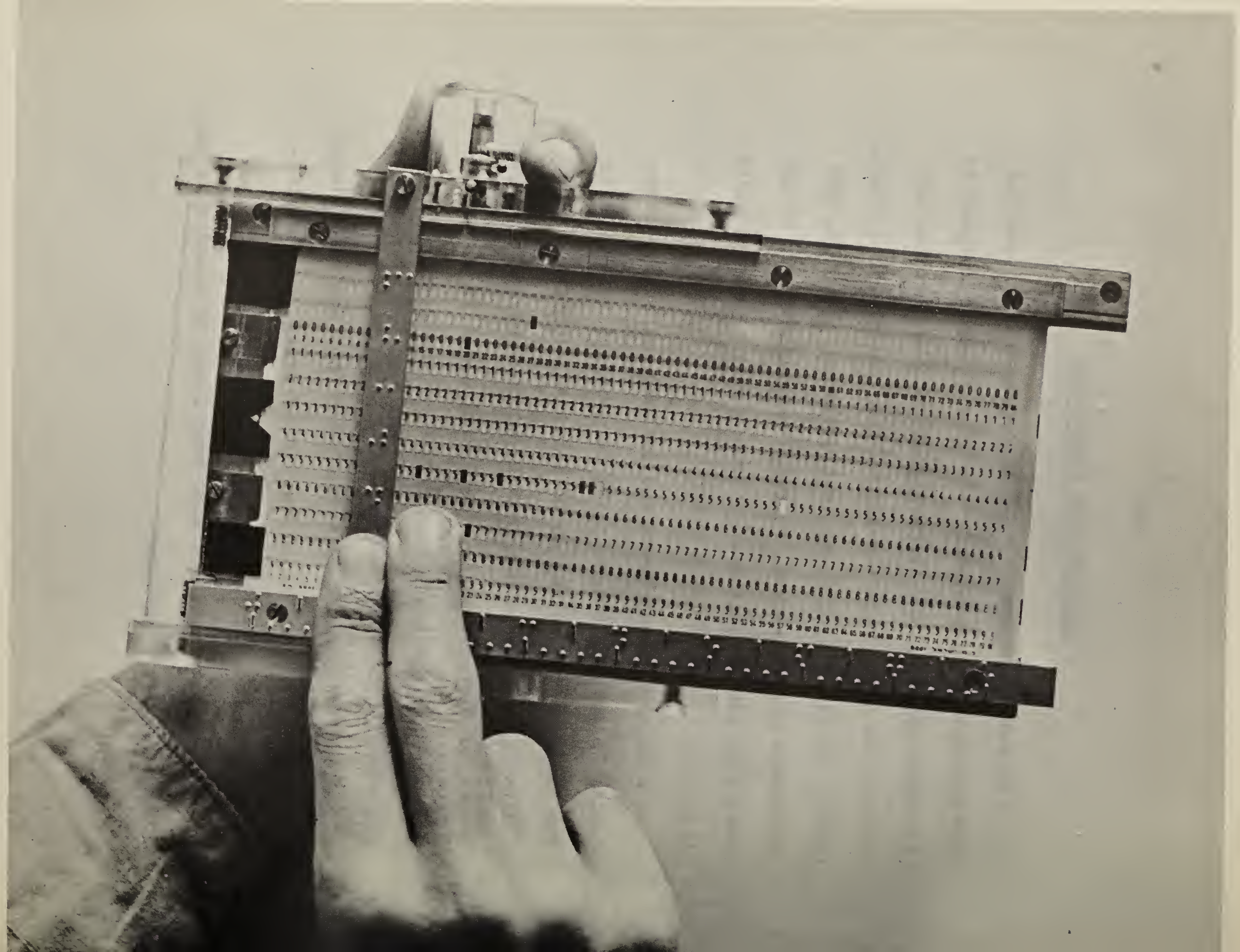
A test sheet such as the above covers all the relevant information regarding all the machines and also allows for checking totals and making evaluations. Generally there is no norm regarding the percentage of mistakes and jams that can occur during the work - this is dependent on the file, on the operator and on the machine. But when the test is on the same machine and the same file, and the only variable is the trainee, a positive indication concerning the quality of the work and the number of jams can be obtained.

CARD-READING INSTRUMENT

It was found that the blind operator could operate the machines more independently of sighted colleagues if he could identify the light signals of the machines and also if he could read the information punched in a single card. At the same time as instruction in operating IBM equipment was continued, research was carried out at the Center on how to enable the blind operator to accomplish this.

A suitable instrument was devised and built, necessarily in several stages owing to constant reference to the trainees themselves as to their suitability. The following illustrations show the various stages of development of the instrument. The final model is a combination of both the light-identifier and the card-reader, and with it the blind operator can identify the light signals of machines such as Collator 088, and read single cards such as cards which are out of order, or checking-cards prepared for just-wired control panels.

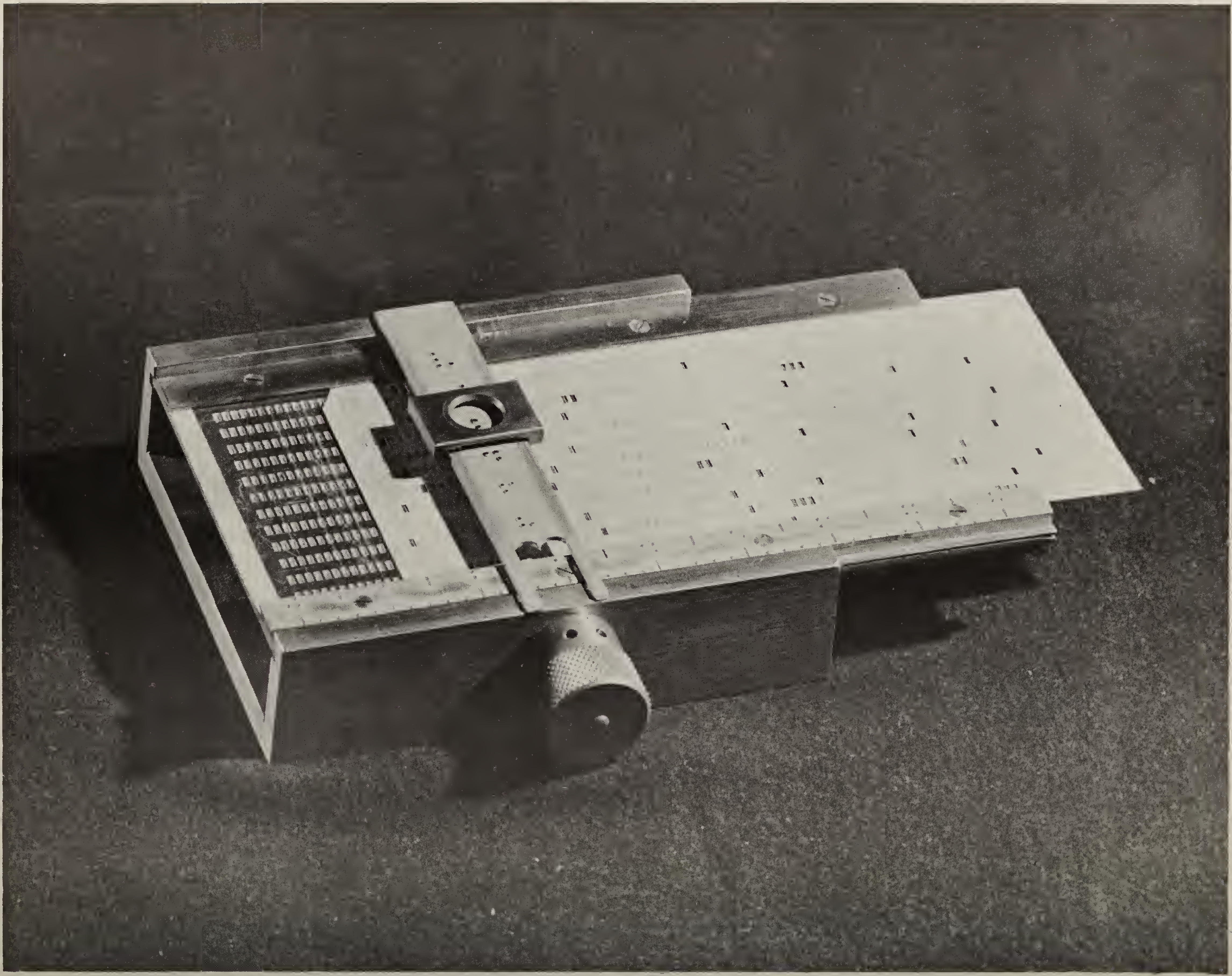
This instrument has also been found of benefit to the blind computer programmer.



The first model is based on standard IBM star wheels. These star wheels are used in the punch-card machines and verifiers. The card to be read is pushed between a thin plastic plate with (80x12 =) 960 punches (corresponding to a fully punched card) and twelve star wheels, which are combined on a vertical axis. When a wheel comes to a hole in the checked column one point enters it and goes through the plastic cover. As this point protrudes from the plastic plate, it can be felt.

The instrument has two braille indices: a horizontal one for the columns and a vertical one for the rows (only for the pairs (12, 0, 2, etc.). By rotating the knob (a click is heard when a column is reached), the blind operator can move the wheel stars' axis according to the horizontal braille scale, and by moving a finger vertically, can feel the point of the star, should one protrude. At the same time he can read by means of the vertical scale in what row the star point protrudes, and in this way can tell what is punched in the column.

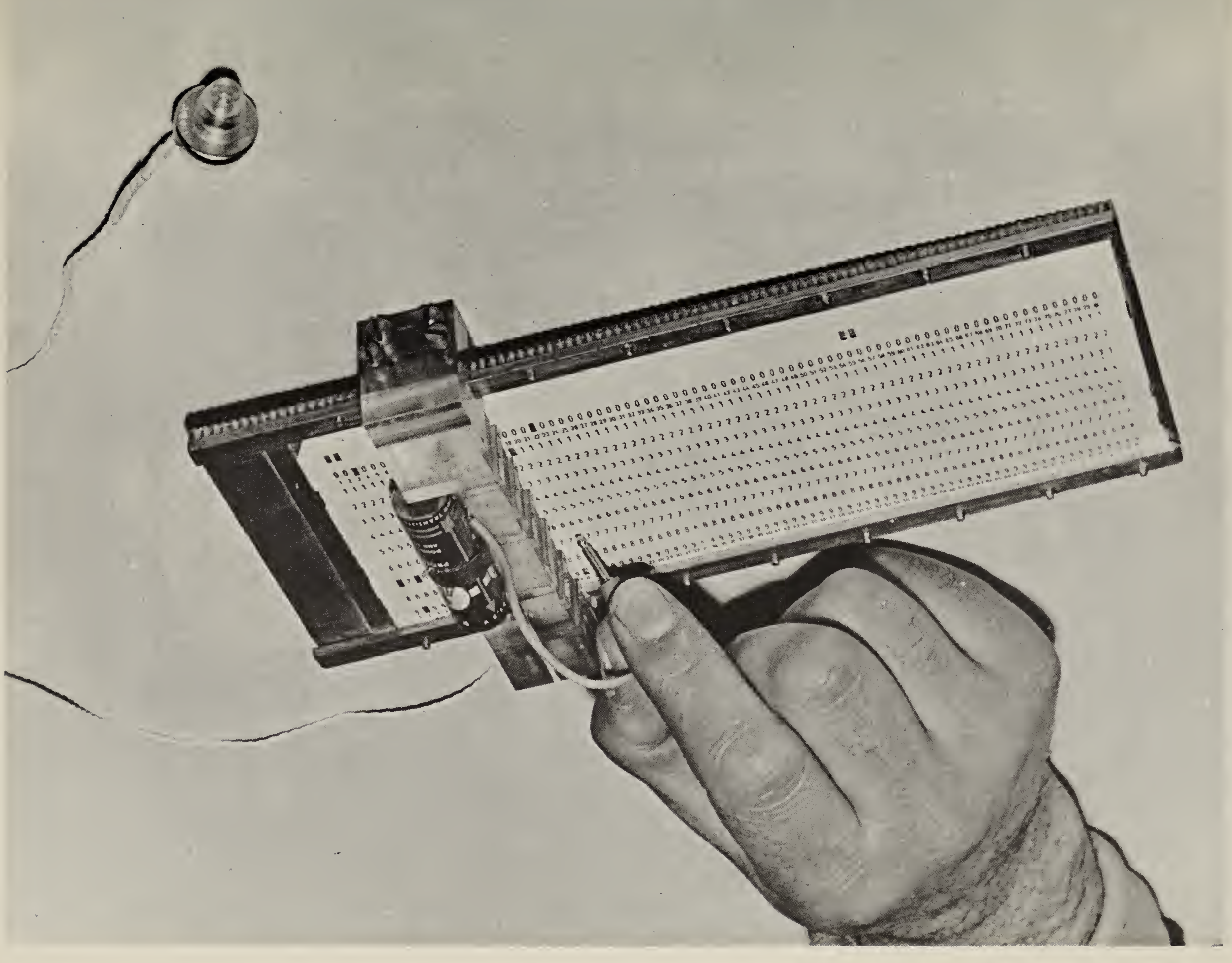
The disadvantage of this model was that it was found to be impossible to obtain a plate (plastic or metal) that could be fully punched and at the same time remain flat and firm. The points of the stars are approximately 1 mm. in length, so a thick plate cannot be used.



The second model was constructed of slightly heavier metal to increase stability. The basic principle of this model consisted of engraving (80x12 =) 960 shallow grooves on a zinc plate to match a fully-punched card. Like the first model, a knob was turned which moved the plate from column to column, with attendant clicks. The horizontal braille scale is identical to that of the first model, but the vertical braille scale had a small metal block fitted. This block had a tiny roller at the bottom and a hole drilled at center to enable it to move up and down the vertical braille scale. As it moved, and with appropriate pressure, the tiny wheel entered the grooves.

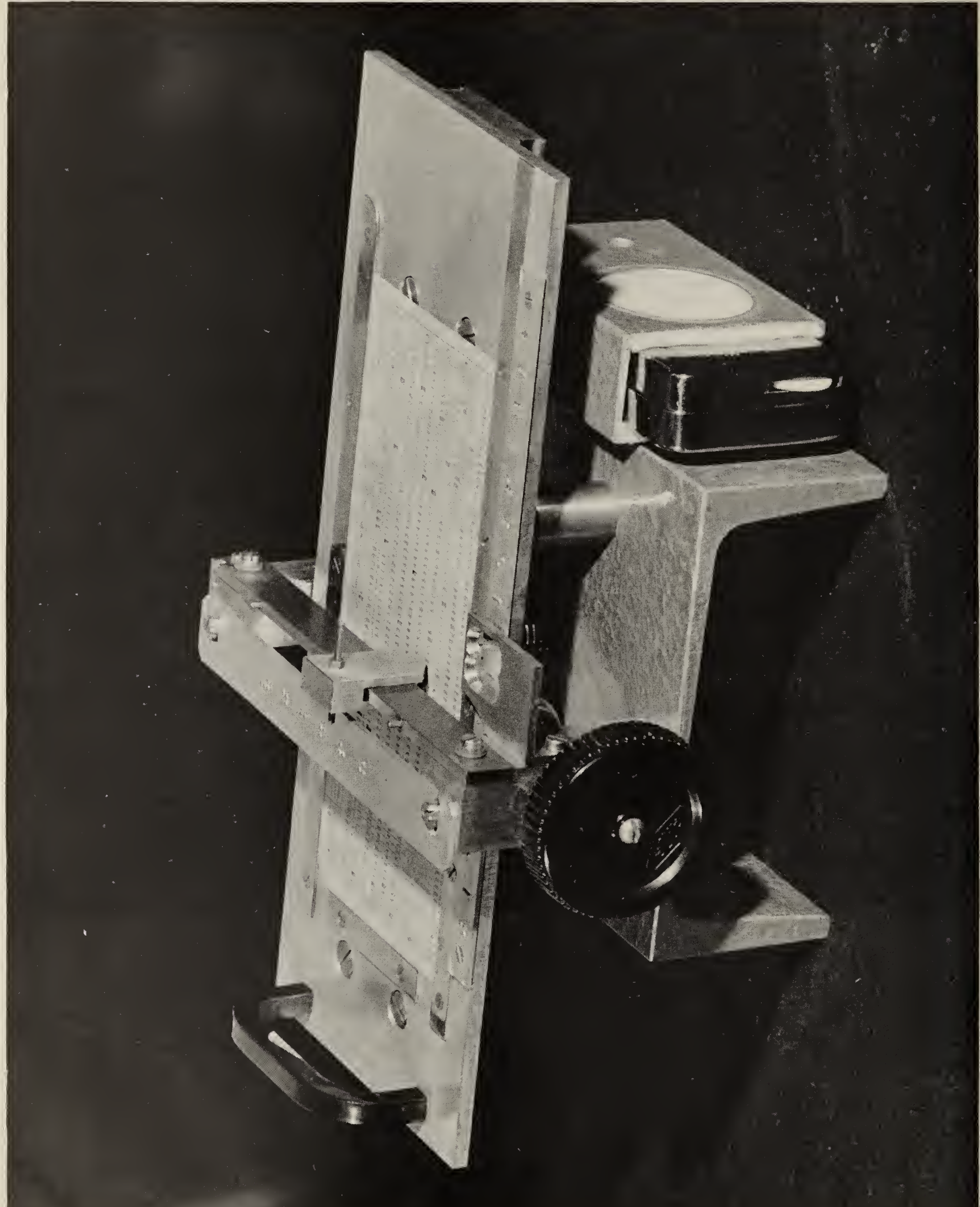
The punch card to be read slid easily between the plate and the vertical scale. The blind operator turns the knob to the chosen column, and then moves the block, at the same time depressing it to meet the card, and the tiny roller enters a punch in the card and stops there. The blind operator can read in the upper hole of the block the number at which it has come to rest.

The disadvantage of this model was that the blind operator could not easily regulate his pressure on the block and consequently the card was damaged, rendering it impossible to feed it into the IBM machine.



The chief difference between the third model and its predecessors was the fact that electric components were here introduced. On the edge of a metal plate 17 pins to mark the division of the 80 columns into 16 sections (each subdivided into 5 notches, the 17th pin marking zero) were introduced to replace the horizontal braille scale. The vertical scale was made of solid plastic. Grooves marking the scale of rows were etched in the right edge of the plastic block, which had a cavity fitted with a battery.

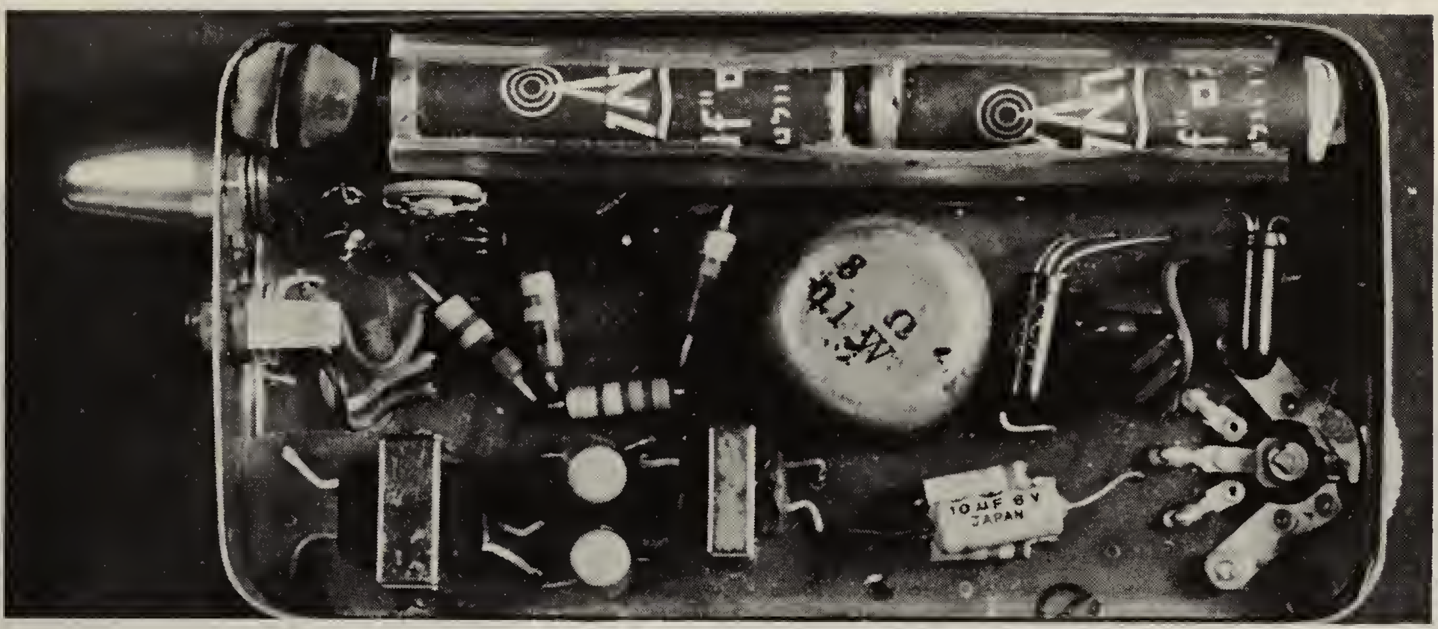
The card to be checked slid between the metal plate and the plastic block. The block is moved by pulling it towards the required column. A ball-bearing provided the necessary 'click' indicating the columns. A contact-wire was then moved along the vertical row-scale and on reaching a punch it made electric contact, producing a buzzing sound conveyed to the blind operator by means of an earplug. The operators, however, intensely disliked the need for earplugs. In addition there was a certain mechanical complication in regard to moving the plastic block from column to column.

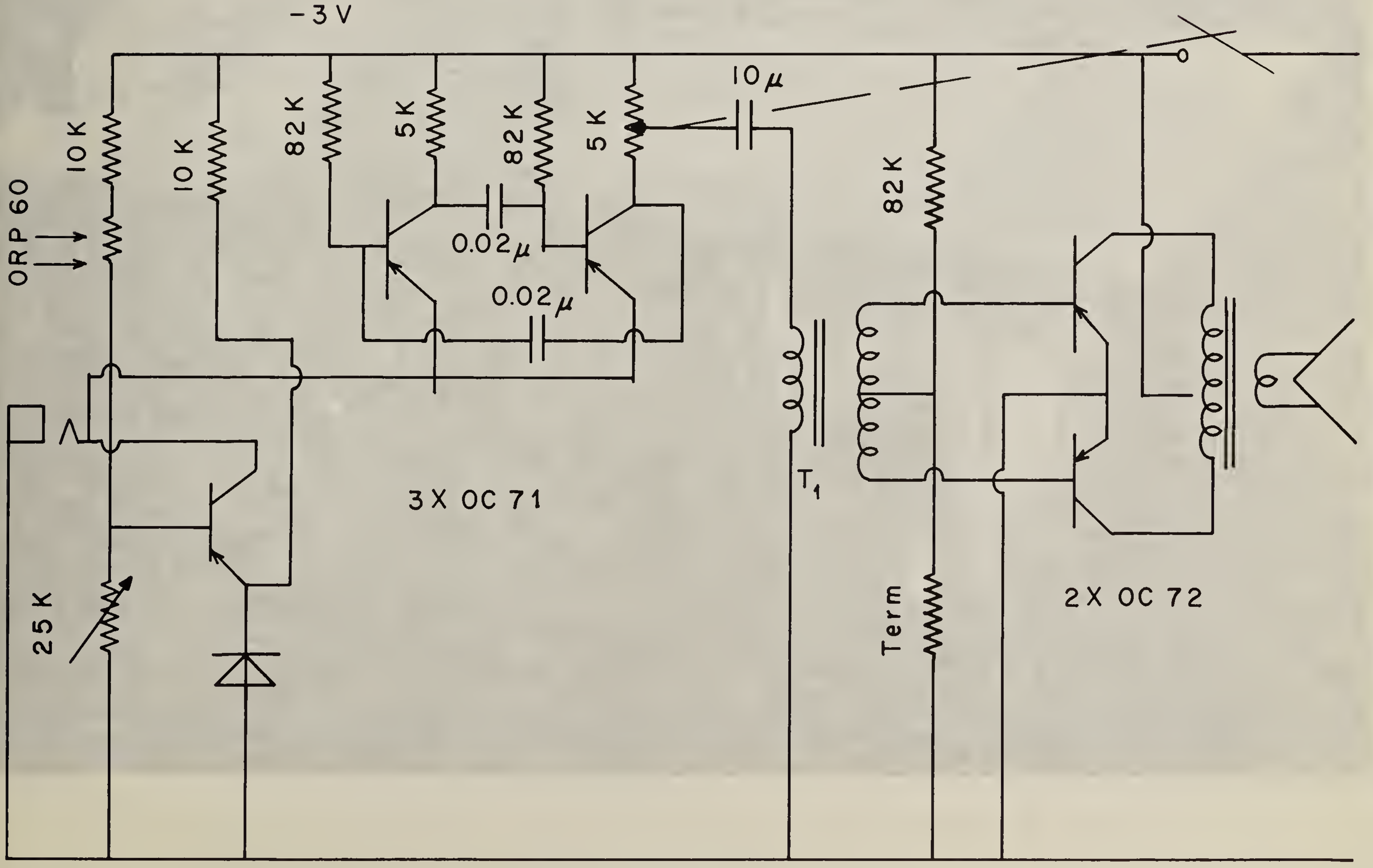


The fourth and final model is a combination of both instruments - the light-identifier and the card-reading instrument. It resulted in a heavier instrument which could remain fixed, thus providing additional stability. This instrument consists of electronic components. It has horizontal and vertical braille scales and can be moved from column to column by turning a knob or by sliding it freely along the scales, after releasing a release-lever. The latter lever is capable of regulation by the operator either to intensify the click or to meet expansion vagaries of the weather.

Instruction for the use of these instruments are detailed on page 62.

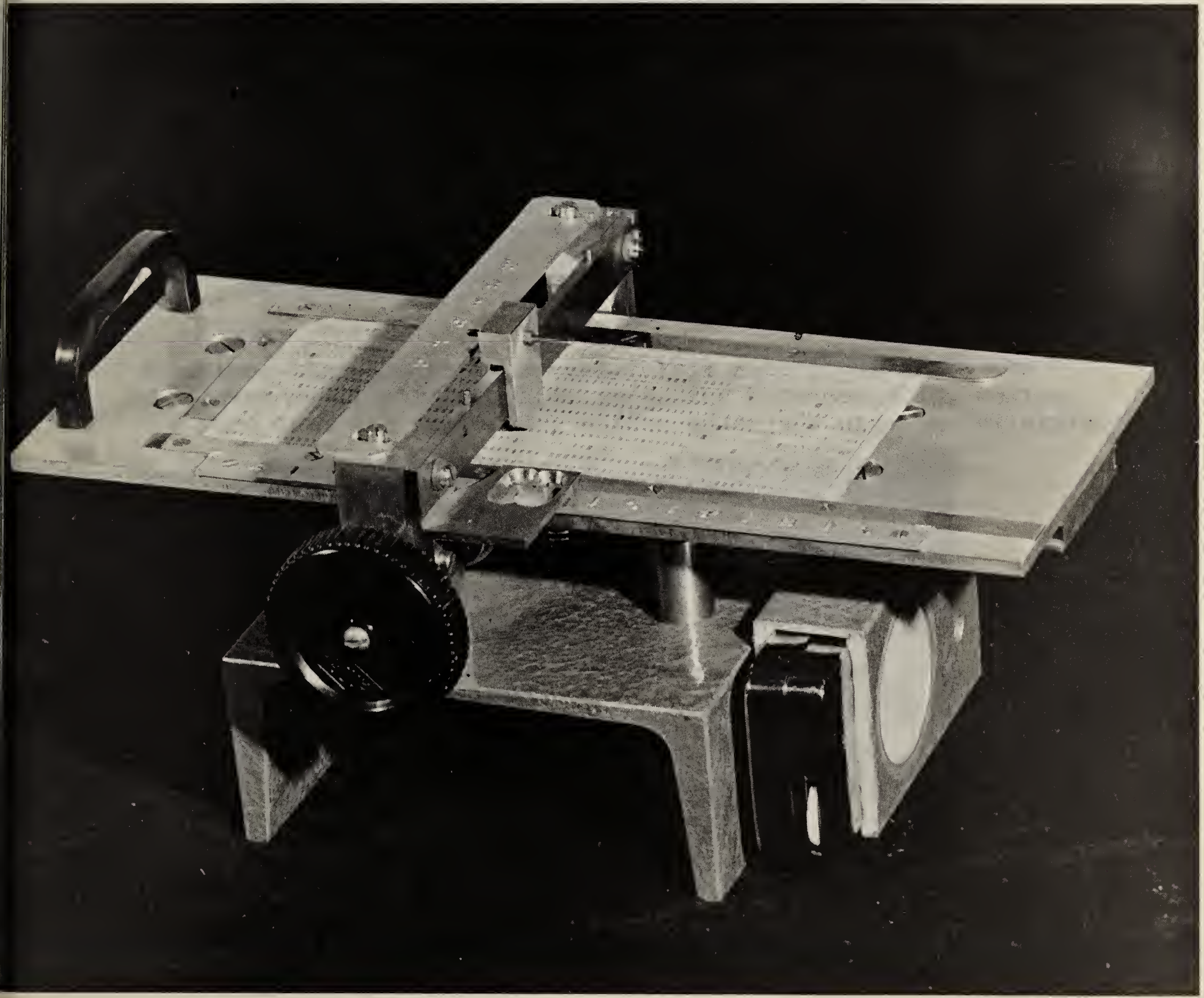
LIGHT IDENTIFIER

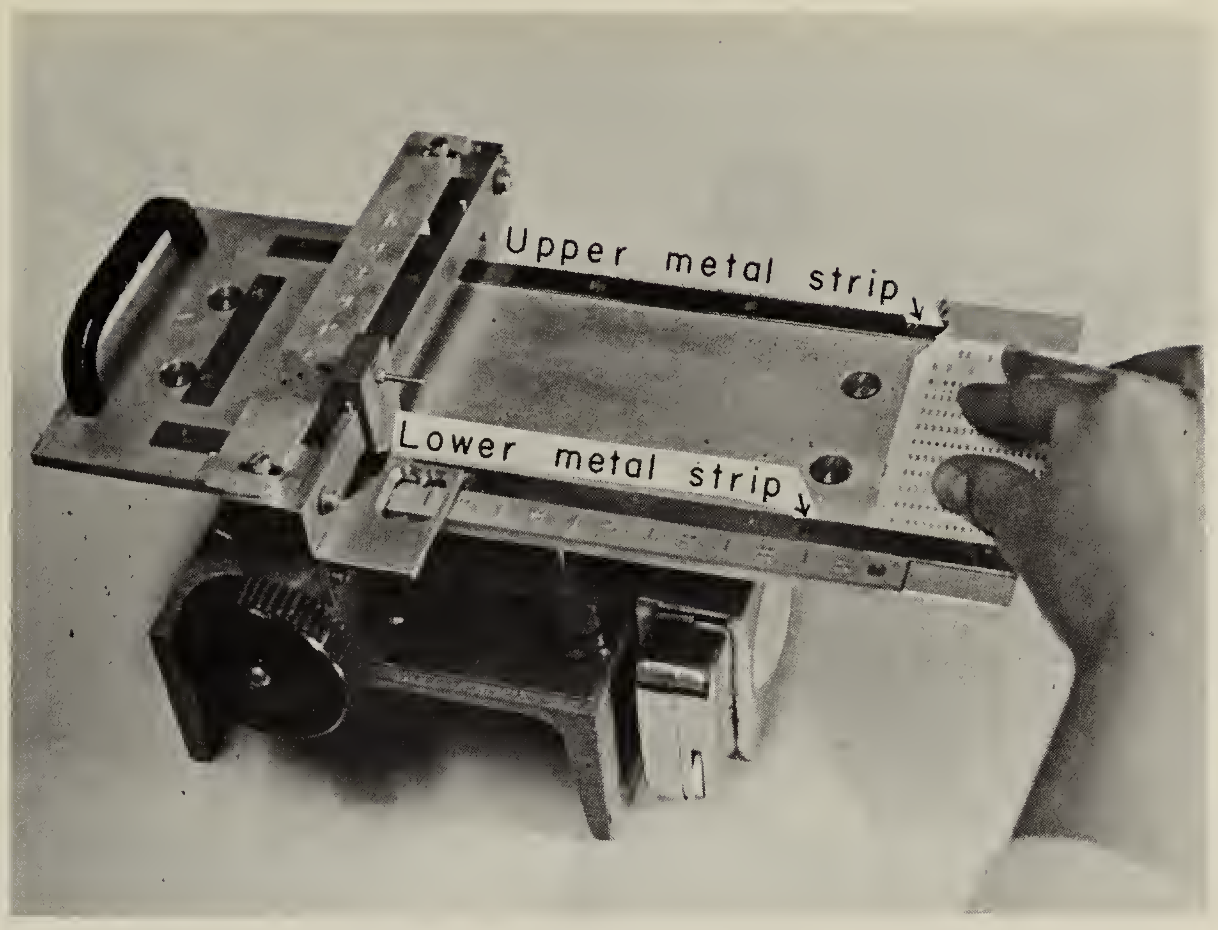




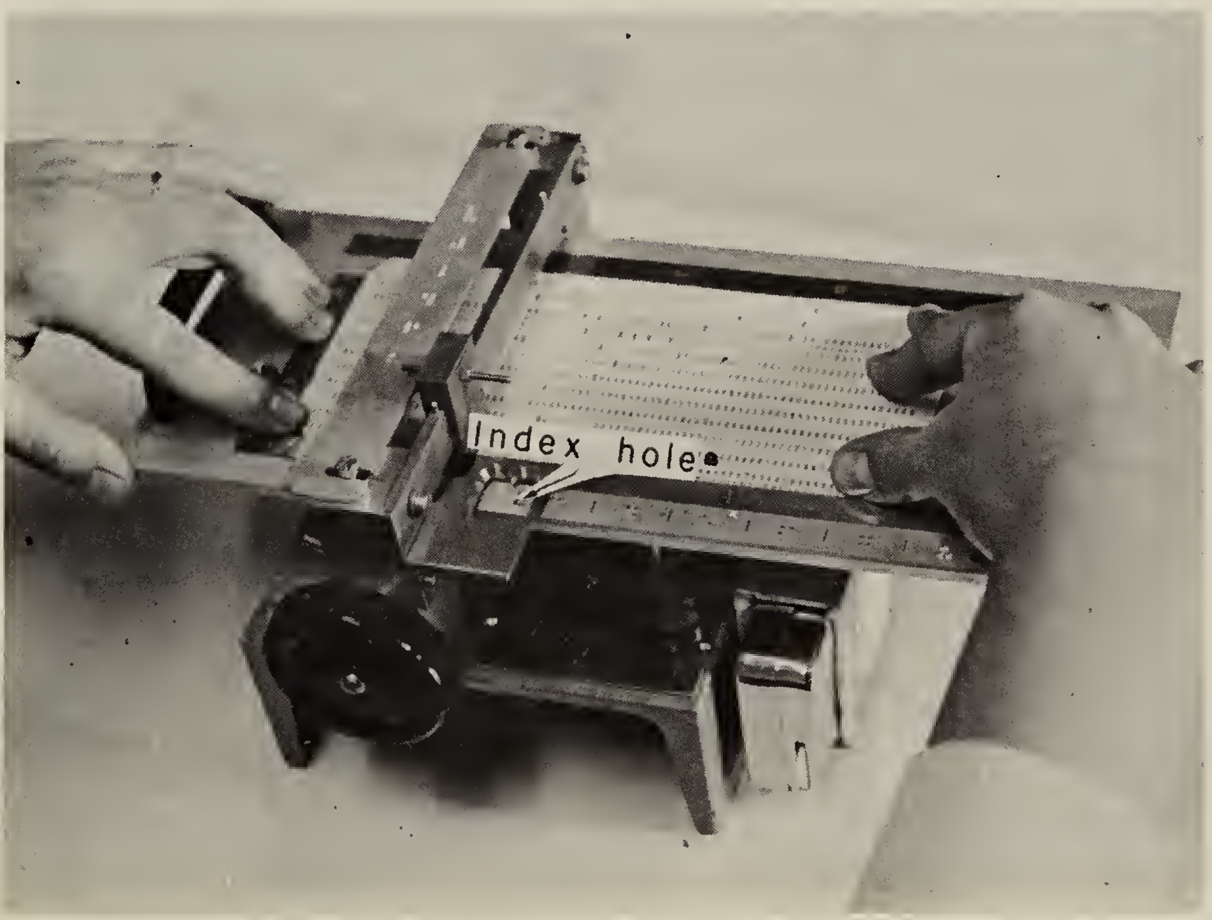
INSTRUCTIONS FOR THE USE OF IBM CARD-READING INSTRUMENT FOR THE BLIND

Designed by: Ezra Shapir, Jerusalem, Israel.
Mechanical Construction: Zecharia Barak, Jerusalem, Israel.
Electronical Construction: Moshe Palmai & George Grunwald, The Hebrew University, Jerusalem, Israel.



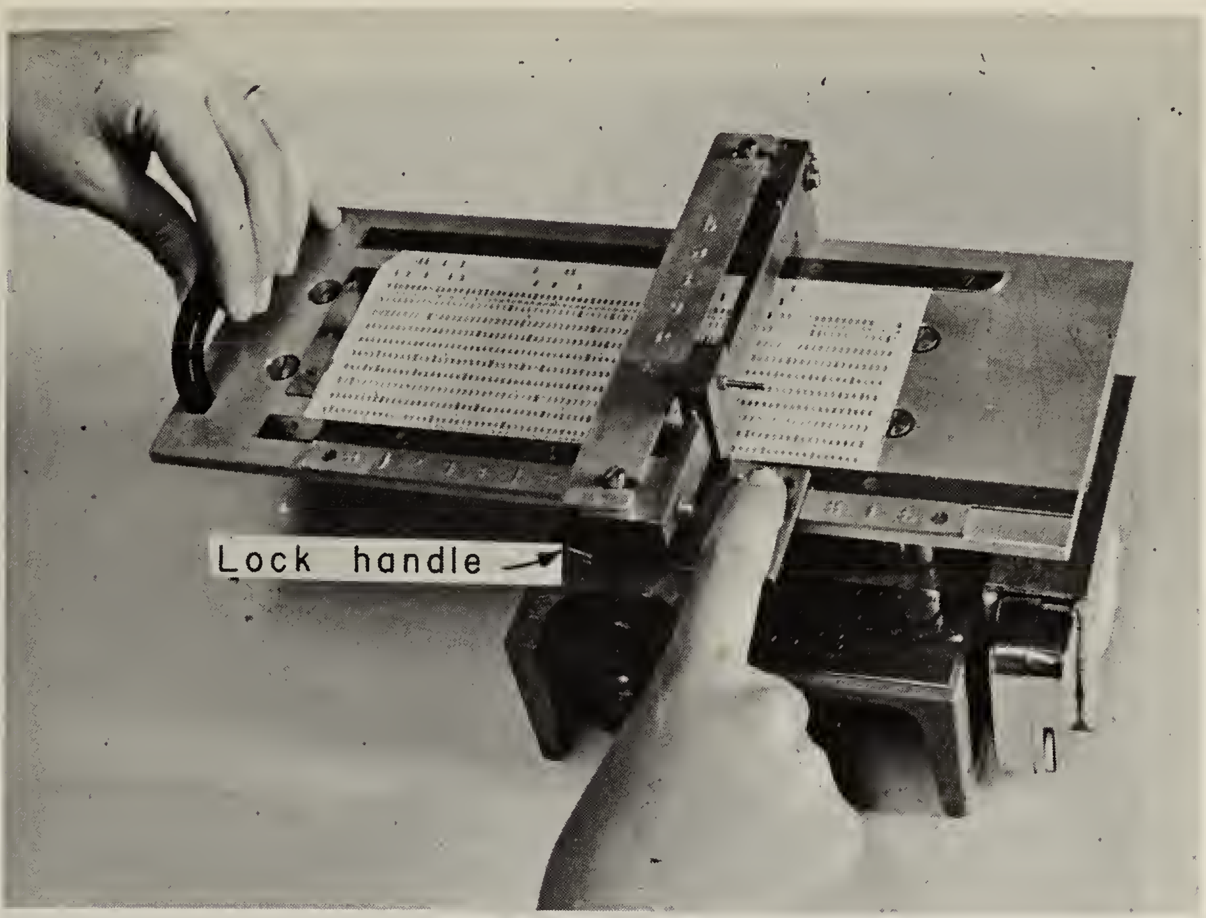


1. Place the card with the upper left corner cut under the lower metal strip. Slide it to the left about 1", making sure that the upper edge slides under the upper metal strip.

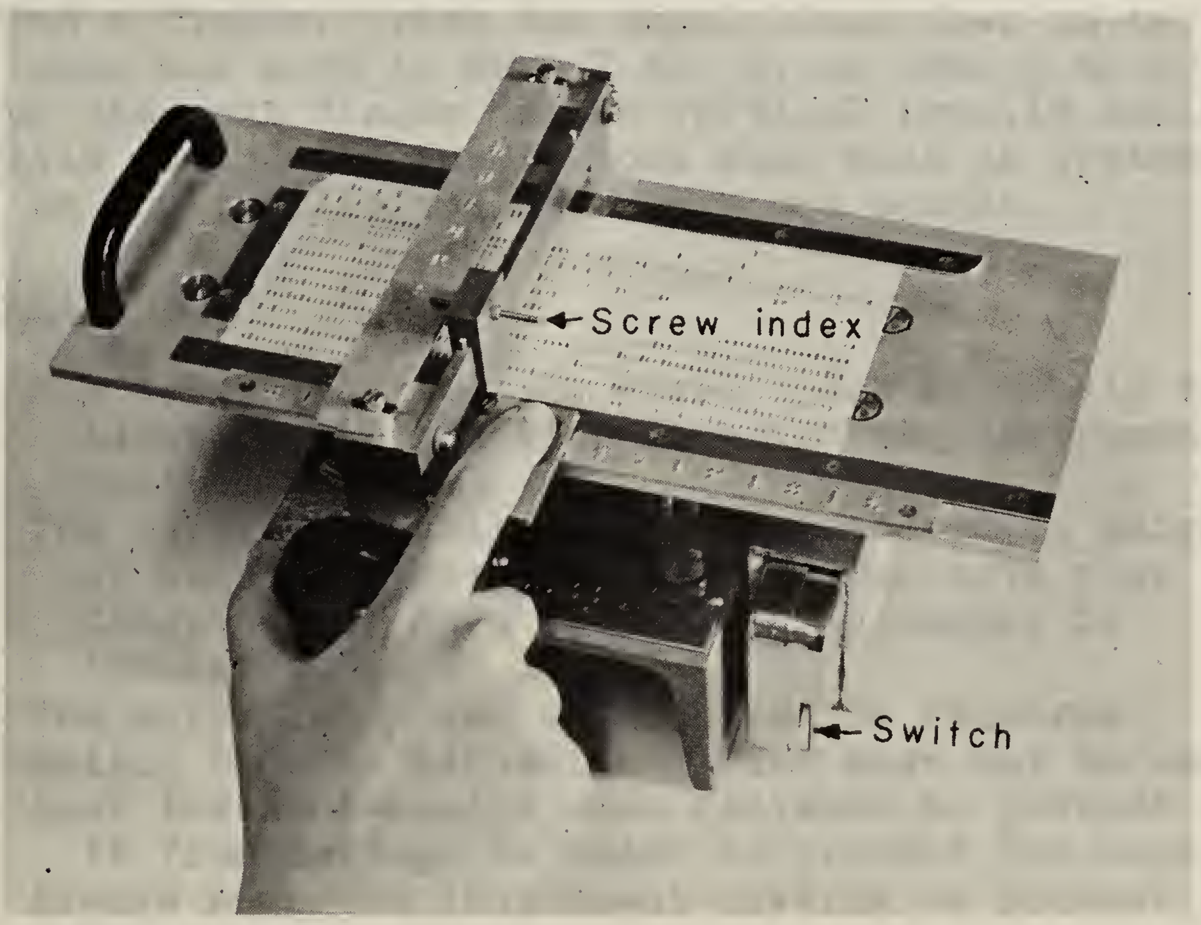


2. Continue pushing the card until it is stopped by the vertical metal strip on the left.

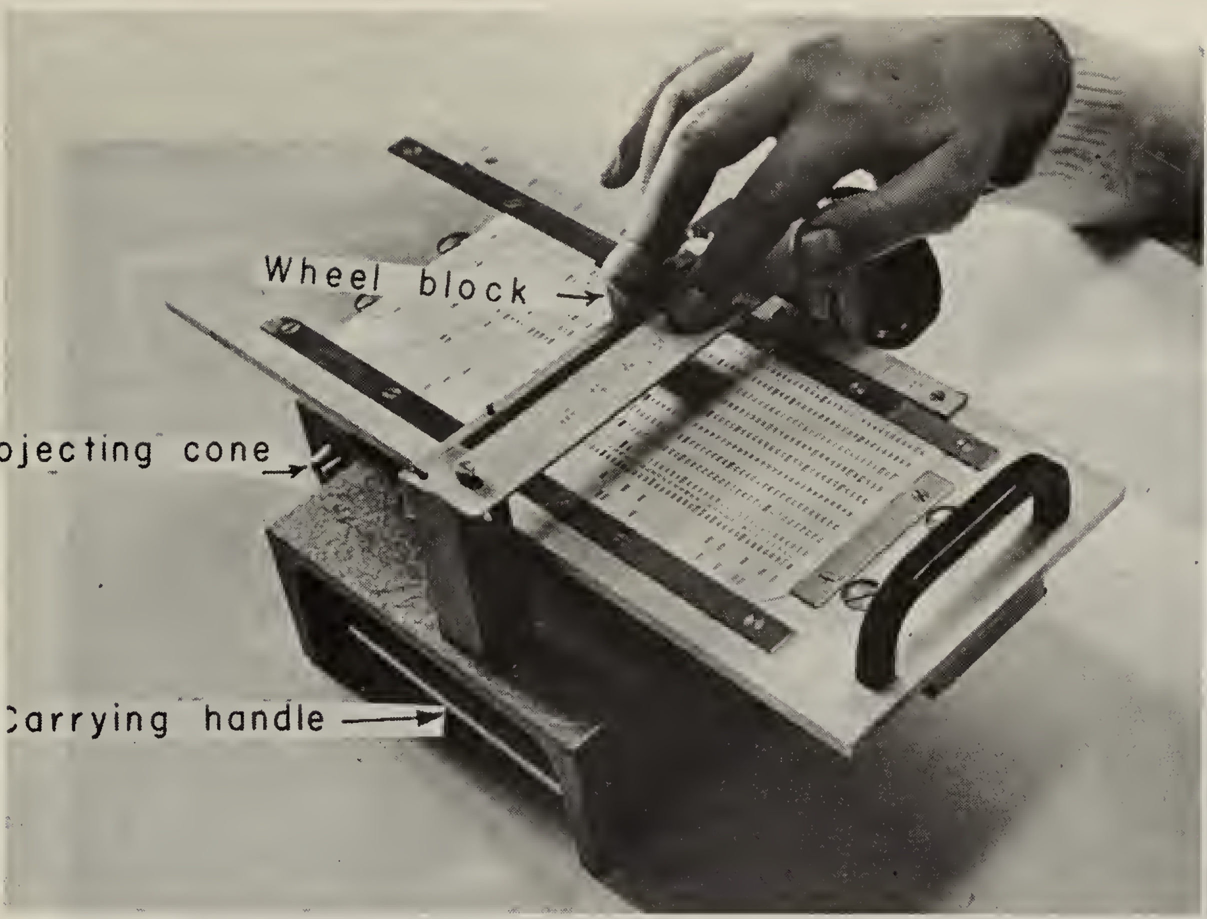
3. Place 1st finger in the index hole so that the braille ruler can be felt. Turn the knob in required direction.



a) The lock handle can be opened and the card bed moved upwards, to the left or to the right. This method is the quickest.



b) The handle can be locked and the knob turned column by column.

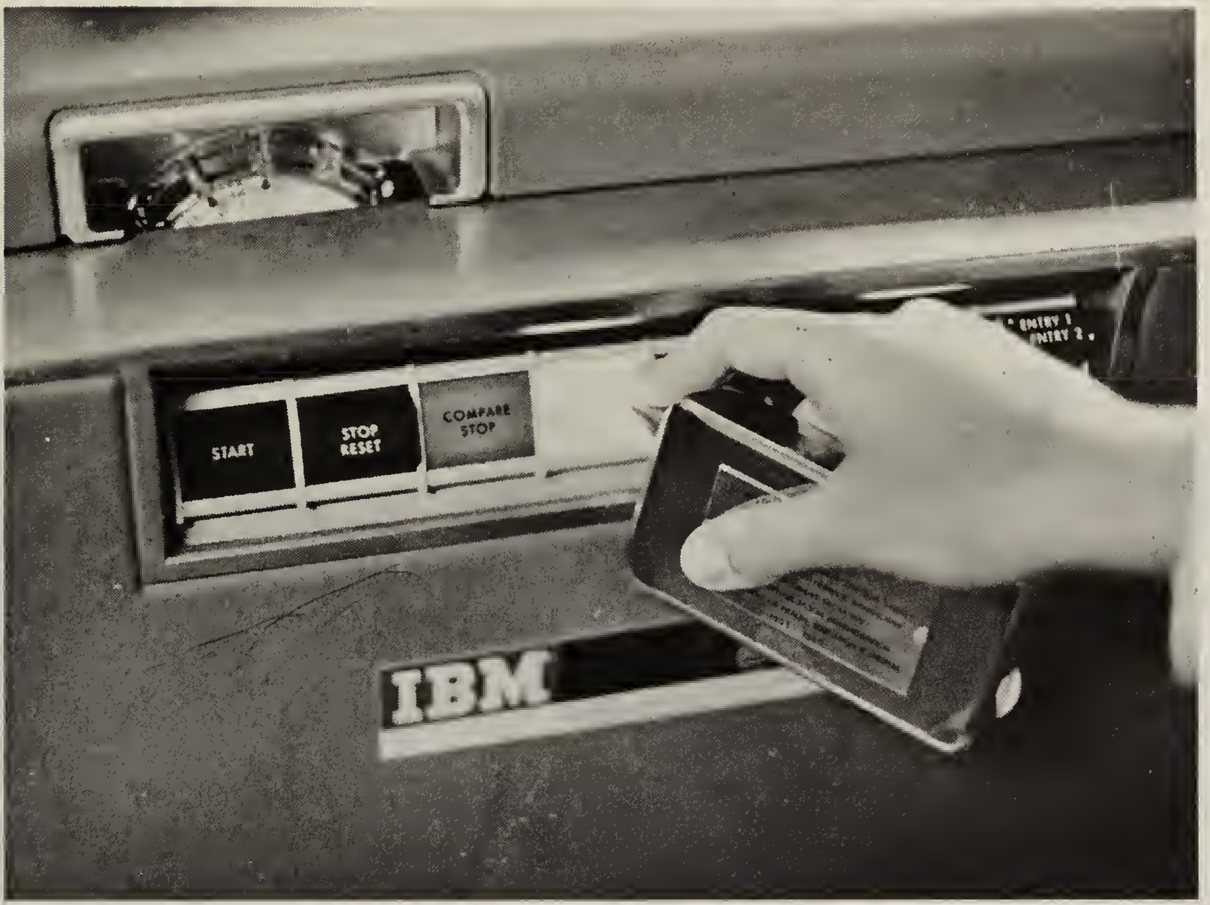


4. Switch on the light-identifying instrument. Turn up volume.

   a) With a finger, press the wheel block down on to the card and move it from V to 9, or from 9 to V.
   b) Put the next finger on the vertical braille scale.
   c) While moving the wheel-block read what is written on the braille scale through the sounds.

Remarks:

i) The screw index on the wheel block will help to identify the position in which the instrument emitted a buzz.
ii) The vertical braille scale is numbered in pairs. If it sounds between the numbers, move your finger up or down to find which number is indicated.
iii) The screw index can be adjusted as required.
iv) Switch off the light-identifier when not in use.
v) Lock the lock-handle when finished to prevent it from moving, in order to protect the card bed.
vi) Always keep the instrument covered to protect it from dust.



1. Hold the light-identifier in front of the panel of the machine.

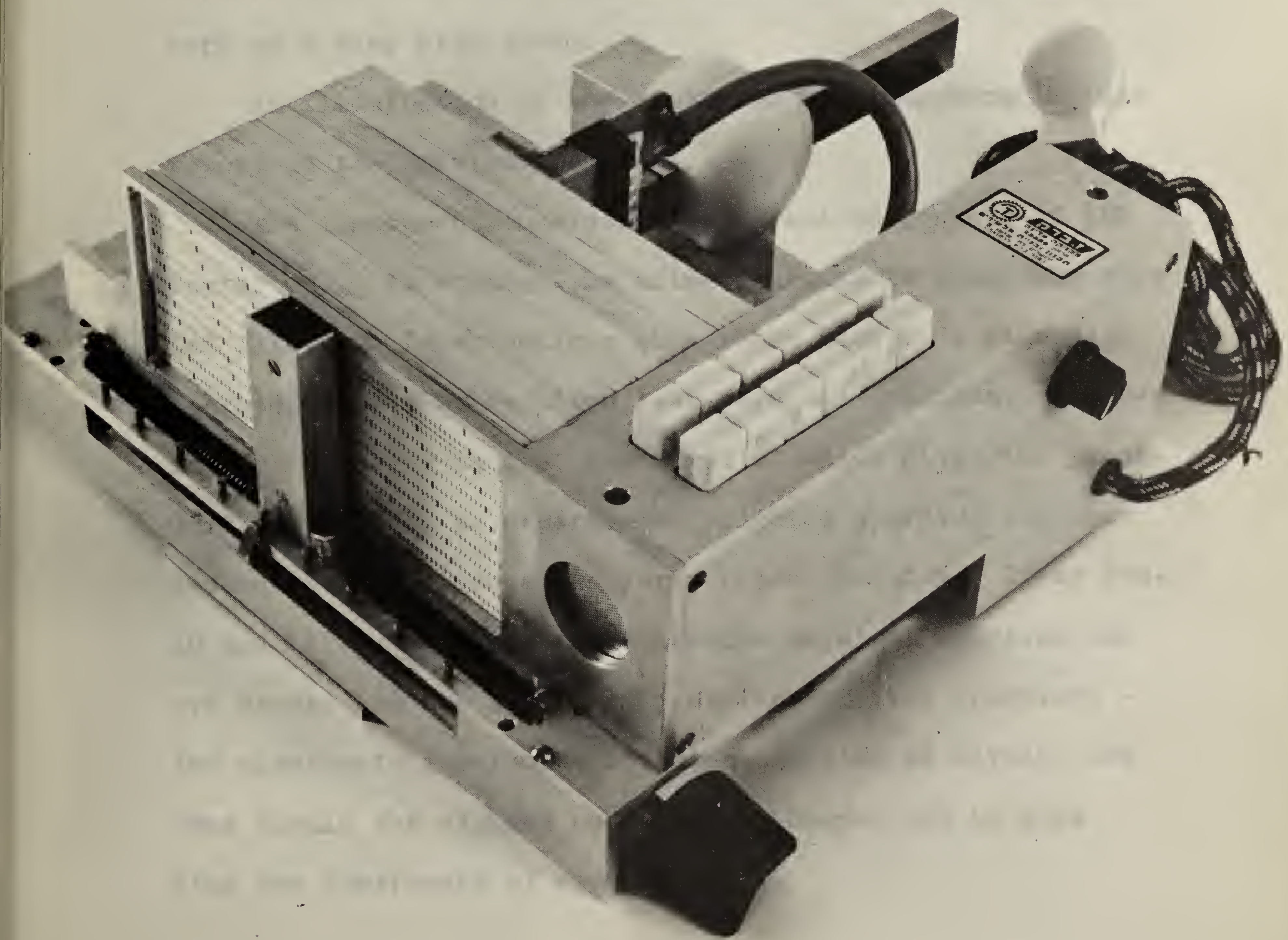
2. Switch light-identifier on. Move the instrument along the panel until the position of the light on the panel can be pinpointed with the index finger.

Remarks:

The operator must know the series of keys and light in the machines by heart. Otherwise braille indications have to be attached.

CARD-CHECKING INSTRUMENT

Designed by:	Ezra Shapir, Jerusalem, Israel.
Mechanical Construction:	Zecharia Barak, Jerusalem, Israel.
Electronical Construction:	Moshe Palmai & George Grunwald, The Hebrew University, Jerusalem, Israel.



In Report No. 2 at the conclusion of the chapter on the development of a card-checking instrument (p.57) it was mentioned that since preparation of that report an electronic instrument for card-checking had been designed and was in process of construction. With that instrument it was anticipated that the blind operator would be able to perform the work at a very high speed.

An illustration of the completed model appears in this report on the previous page.

The instrument consists of standard components of IBM Sorter 083. It enables the blind operator to check the sorted file with fewer motions than those used by a sighted operator, and also requires less physical exertion, as shown in the following tables, the first of which gives the procedure followed by an experienced, sighted operator and the second shows the procedure for a blind operator. Items Nos. 10 and 11 of the first table involve physical exertion and eye strain and are accordingly disliked by the operators - the electronic instrument obviates any kind of strain, and thus should the sighted operator use Sorter 083 he will find the instrument of equal benefit.

OPERATION : Taking out cards from one pocket, checking, and inserting in the feed or in a card rack

MACHINE : IBM sorter 083

INSTALLATION: Data Processing Center, Internal Revenue, Minister of Finance

No.	Left Hand	Mark	Eye	Mark	No.	Right Hand
1.	Idle	○	👁	←	1.	Goes to stop knob
2.	Idle	○		☼	2.	Presses stop knob
3.	Idle	○		←	3.	Goes to pocket joggler
4.	Goes to a full pocket	←	👁	☼	4.	Pulls (opens) pocket joggler
5.	Pushes cards down (making room for exit)	☼		○	5.	Idle
6.	Transfers cards to upper machine cover (right side)	→	👁	☼	6.	Closes pocket joggler
7.	Puts cards on upper machine cover (right side)	☼		☼	7.	Helps to put the cards on upper machine cover
8.	Knocks on the left of the cards 2-3 times to straighten	☼		€	8.	Clasps the group of cards
9.	Clasps the group of cards	€		☼	9.	Knocks on top of the cards
10.	Clasps the group of cards	€		€	10.	Holds the group of cards
11.	Lifts the group of cards to eye level (face down)	→		→	11.	Lifts the group of cards to eye level (face down)
12.	Precises the group of cards	☼	👁👁	☼	12.	Precises the group of cards
13.	Brings down the group of cards and turns it face down towards operator	→		○	13.	Idle
14.	Transfers the cards to right hand	→		☼	14.	Receives the cards from left hand
15.	Idle	○		→	15.	Transfers the cards to feed or to card rack
16.	Idle	○		☼	16.	Puts the cards in the feed or card rack

TAKING CARDS OUT OF A POCKET, CHECKING AND INSERTING IN THE FEED HOPPER OR IN A CARD RACK

No.	Left Hand	No.	Right Hand
1	Place on pocket joggler	1	Place on stop key
2	Pull pocket joggler open	2	Press stop key
3	Place on Braille number in the pocket	3	Place on a full pocket
4	Read the Braille number	4	Push cards down (making room for exit)
5	Close pocket joggler	5	Transfer cards to card checking instrument
6	Knock on the left side of the cards 2-3 times to straighten them	6	Hold the group of cards
7	Hold the group of cards	7	Knock on the top of the cards 2-3 times
8	Hold the group of cards	8	Push the selected key
9	Take out the cards	9	Help take out the cards
10	Transfer the cards to feed hopper or to a card rack	10	Help transfer the cards (if to the card rack read the Braille number in the card rack)

Note: 1. The instrument has to be adjusted at the same column as the brush.

2. On this job the tasks of the different hands can be interchanged, depending on the place of the full pocket, the punches which are to be checked and the comfort of the operator.

77 COLLATOR - TIMING CHART

Machine Cycle: 223°-223°
Digit Time: 0° - 186°
Control Time: 185°-223°

Control Panel Hubs	Exit, Entry	note	Location	Normal Time	Possible Time
ALPHABETIC COLLATING DEVICE					
Secondary Zone Read	Ex	12	15/1-16	0:18-26 X:36-44 V:54-62	
Primary Zone Read	Ex		16/1-16	"	
Primary Seq. Zone Read	Ex		17/1-16	"	
BASIC SETUP SWITCHES,					
S,E,P (Center)	En	1	8-10/19	198-223	185-223
S,E,P On	Ex		8-10/20	198-223	
Mult. S & S Off	Ex		11/18	198-223	
Mult. S & S (Center)	Ex En	2	11/19	198-223	
Pri Change Off	Ex		12/18	185-223	
Pri Change (Center)	En		12/19	185-223	
Pri Change On	Ex		12/20	185-223	
COMPARING ENTRIES,					
Primary Selector Entry	En		24-25/1-16	9:0-8	0-18
				8:18-26	19-36
				7:36-44	36-54
				6:54-62	54-72
				5:72-80	72-90
				4:90-98	90-108
				3:108-116	108-126
				2:126-134	126-144
				1:144-152	144-162
Secondary Selector Entry	En		22/1-16	"	"
1st Primary Sequence "			23/1-16	"	"
2nd Primary Sequence "			30/1-16	"	"
CONTROL EXITS,					
Low Sec.	Ex	3	1/1-4	185-223	
Equal	Ex	3	2/1-4	"	
Low Pri.	Ex	3	3/1-4	"	
High Pri Seq.	Ex	4	4/1-4	"	
Equal Pri Seq.	Ex	4	5/1-4	"	
Low Pri Seq.	Ex	4	6/1-4	"	

Control Panel Hubs	Exit, Entry	note	Location	Normal Time	Possible Time
CONTROL INPUTS					
Selector	En		22/19	185-223	
Primary Sequence	En		22/20	185-223	
(Exits)	Ex		23/18-20	185-223	
COUNTING DEVICE					
Control Carry (Exit)	Ex		8/15	270-342	
" " (Entry)	En		9/15	270-342	
" Trans (Exit)	Ex		8/16	9:0-8 8:18-26 7:36-44 6:54-62 5:72-80 4:90-98 3:108-116 2:126-134 1:144-152 X:180-188	
Control Trans. (Entry)	En		9/16	"	
" Reset U,T	En		8-9/17	185-223	(0-223)
Count In U,T	En		8-9/3	185-223	(122-270)
Count Source S,C,P,PS	Ex	1,13	8-9/1-2	198-223	
Runout P,S	Ex	14	7/1-2	185-223	
Total Units 0-9,C (Transfer Jackplugged)	Ex	15	8/4-14	9:0-8 8:18-26 7:36-44 6:54-62 5:72-80 4:90-98 3:108-116 2:126-134 1:144-152	
Units 0-9,C (Transfer not Jack-plugged)	En	16	8/4-14	185-223	(0-264)
Tens 0-9,C		16	9/4-14	9:0-8 8:18-26 7:36-44 6:54-62 5:72-80 4:90-98 3:108-116 2:126-134 1:144-152 Cont:185-223	(0-264)

Control Panel Hubs	Exit, Entry	note	Location	Normal Time	Possible Time
CYCLE DELAY,		5			
Pickup	En		7/5-6	185-223	156-320
" Spee.device			6/5-6		
Dropout	En		7/10	185-223	156-320
" " "			6/10		
Common	ExEn		7/7	198-223	228-228
" " "			6/7		
Normal	ExEn		7/8		236-322
" " "			6/8		
Transfer	ExEn		7/9	198-223	322-236
" " "			6/9		
FUNCTIONAL ENTRIES					
Sec.Select 4,3	En		1/17-20	185-223	
Pri.Select 1	En		2/17-20	185-223	
Sec.Feed	En	1,6	3/17-20	185-223	
" "	Ex	1,6	3/17-20	198-223	
Pri.Eject	En	1,7	4/17-20	185-223	
" "	Ex		4/17-20	198-223	
Pri.Feed	En	1,6	5/17-20	185-223	
" "	Ex	1,6	5/17-20	198-223	
Error Stop	En	8	6/17-20	185-223	0-223
INTERLOCK SWITCH,					
Center	En		13/19	144-236	
On	Ex		13/20	144-236	
PLUG TO C	Ex		1-5/7	198-223	
READ BRUSHES					
Primary	Ex		26-29/1-20	9:0-8 8:18-26 7:36-44 6:54-62 5:72-80 4:90-98 3:108-116 2:126-134 1:144-152 X:180-188	
Primary Sequence	Ex		31-34/1-20	"	
Secondary	Ex		18-21/1-20	"	

Control Panel Hubs	Exit, Entry	note	Location	Normal Time	Possible Time
RESTORE					
S,P,PS1, PS2 (entry)	En		24/17-20	198-223	185-223
sec. restore (exit)	Ex	9	25/17	198-223	
sec. restore (entry)	En		25/17	185-223	
Primary restore (exit)			25/18-20	198-223	
Primary restore (entry)			25/18-20	185-223	
SELECTORS,		10			
Pickup	En		1-5/5-6	185-223	
Common	EnEx		1-5/8	198-223	228-228
Normal	EnEx		1-5/9		223-185
Transfer	EnEx		1-5/10	198-223	185-223
X SELECTORS: PRI.		11			
Pickup	En		30/17-18	180-185	(174-196)
" Special device			1/11-12		
Common	ExEn		7/11	185-223	(228-228)
" " "			6/11		
Normal	ExEn		7/12	236-180	
" " "			6/12		
Transfer	ExEn		7/13	185-223	(180-236)
" " "			6/13		
X SELECTROS: SEC.		11			
Pickup	En		30/19-20	180-185	174-196
" Spec. device			2/11-12		
Common	ExEn		7/14	185-223	228-228
" " "			6/14		
Normal	ExEn		7/15	236-180	
" " "			6/15		
Transfer	ExEn		7/16	185-223	180-236
" " "			6/16		

NOTES

1. Active only when cards are in respective feeds.

2. Normally an entry; can be used as an exit for a low primary condition or an equal with an equal primary sequence condition.

3. Emits impulse wired to SEL (22,19).

4. Emits impulse wired to PS (22,20).

5. When PU is impulsed, the selector transfers before digit time of the next cycle (320°). It remains transferred until the beginning (236°) of the cycle following that in which DO is impulsed.

6. Normally an entry to cause respective feed to operate; becomes an exit when respective feed is impulsed through the basic setup switches.

7. Normally an entry; becomes an exit when the BASIC SETUP E switch or primary feed is impulsed.

8. Must be impulsed at the beginning of control time (185°) or during digit time.

9. Normally exits; can be used as entries to cause respective feeds to operate. Single hub associated with secondary feed; three common hubs associated with primary feed.

10. Remain transferred for the duration of the pickup impulse only.

11. The primary X selector transfers immediately and remains transferred until the beginning (238°) of the next machine cycle in which primary feed operates. The secondary X selector operates in the same manner with respect to the secondary feed.

12. Zone 12 is read as a 6; zone 11 as a 7; zone 0 as an 8.

13. C emits on the cycle in which the first card is read at primary read, and on every machine cycle thereafter.

14. Emit when the opposite feed is empty, with the exception that a primary feed (not an eject alone) must occur before the s hub will emit. They also emit on the run-in.

15. With TRANSFER jackplugged each digit hub becomes an emitter; the C hub emits the digit corresponding to the value in the units counter.

16. A path exists between the C hub and the digit hub corresponding to the value in the counter. Either can be used as an exit or entry.